The International Journal of
Orthodontia, Oral Surgery and Radiography

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VOL. XIII ST. LOUIS, JUNE, 1927 No. 6

ORIGINAL ARTICLES

MALNUTRITION IN CHILDREN*

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TODAY, in this country when we consider our improved ideas of health education and its far-reaching advantages, it is with regret that we are forced to observe so many children who are needlessly suffering from malnutrition.

Malnutrition in children may be said to be present when there is retardation of development or some impairment of tissue-growth resulting either from undernutrition, or because of some altered condition of metabolism. It is practically impossible to determine with what frequency malnutrition exists; suffice it to state that the condition is common. It can be found with too great frequency among the rich who have the advantages of wealth, and it exists to excess in the children of the poor for reasons other than financial. Strange as it may seem, families who have the advantages of higher education do not, apparently, have fewer malnourished children than the uneducated. It is our impression that malnutrition in children exists in as great a proportion in the country as in the city, and that although there is no apparent racial factor in considering this widespread situation, yet, perhaps because the incidence of rickets is greater and it occurs in a more severe form in Italians and in colored people, do we commonly find among their children the more severe forms of malnutrition.

A physical examination is the one and only method of determining the state of the child's nutrition, and inspection of the child unclad is the most important part of the examination. The malnourished child looks and acts the part. His appearance is one of fatigue. His eyes are heavy and sunken and of poor luster. The happy and full expression of the well-nourished child

*Read before the Dewey Study Club, New York, February 15, 1927.

is lacking. This is in contrast to the subdued expression on the long face of the malnourished child. The length of the face is more apparent than real, and is due frequently to the drawing in of the sides of the face because of loss of the subcutaneous tissue. The more common type of malnourished child is characterized by a head which appears relatively enlarged because of his flat chest, which is crowded by a protuberant abdomen, all three of which are ungracefully supported by pronated and pseudoenlarged feet.

Palpation, which is next in importance to inspection, reassures the examiner of the diagnosis. It is usual to feel a dry, nonelastic skin with poor turgor in the malnourished child. There is comparatively little subcutaneous fat, and the more extreme cases are generally emphasized by a marked diminution in the substance of the cheek pads. The muscles are flabby and soft, and do not have that healthy touch which is usually felt in normal children. Cold extremities are often confirmatory evidence of the malnourished child's poor circulation.

In addition to the physical examination, there is much to be obtained from a mental examination of the child. Malnourished children generally show evidence of nervous exhaustion and nervous irritability. Some are fidgety, others are unable to concentrate for any length of time, and a great many are unstable otherwise. In children who are malnourished it is difficult to say just what their individual mental capacity and natural behavior would be. But from clinical observations this much may be said, that as a rule, a betterment of the child's nutrition effects not only an improvement in his mental condition, but also results in a more stable nervous mechanism. On the other hand, should there be a recurrence of the child's poor nutrition, it is apt to be reflected by his abnormal behavior.

While as yet there are no reliable laboratory examinations which may be utilized to determine the malnutritional state of the individual, nevertheless, there are two aids which may be had from the laboratory. The first concerns itself with the basal metabolism, which is frequently lowered when the individual is malnourished, and the second is a diminution of the individual's vital capacity. Both are usually increased when there is an improvement in nutrition.

Just a word regarding the indices of nutrition which are commonly used. The reference here is to the use of such tables as those devised by Baldwin and Wood, Dryer, and Pirquet, as the sole method of determining the state of the child's nutrition. The true nutritional condition of a child cannot be calculated mathematically, and these tables are perhaps unjustly criticized because they are used by many in lieu of, and not merely as a fractional part of, the physical examination.

SYMPTOMS

Although the diagnosis of malnutrition is based almost entirely on the physical examination, the symptoms should not be overlooked. A history carefully taken may furnish not only the cause for the malnutrition, but it furnishes the physician with valuable information which may stand him in good stead when planning the treatment. This history is taken through a

party other than the child, usually the mother, which makes it rather difficult for the physician to obtain an unbiased history, since what is told is usually a reflection of the mother's mind, and she naturally relates what to her is of paramount importance. Incidentally, the history gives the physician an insight into the extent of the mother's knowledge, and also of her wisdom regarding the upbringing of the child.

There are innumerable symptoms which may be traced to malnutrition. As a rule the chief complaints center around, first, the child's failure to thrive "as it should," secondly, the lack of appetite, and thirdly, the nervous irritability or evidence of nervous exhaustion. The child's lack of appetite and his reaction to certain foods may be manifested in countless ways. Sometimes the child has an apathy for all foods, and occasionally if feeding is forced, it vomits or threatens to vomit. The child's nervous exhaustion and his nervous irritability may be manifested in a thousand and one ways, the most important of which is restlessness, both physical and mental.

CAUSES OF MALNUTRITION

Malnutrition results from an insufficient intake of food. If there is an absolute insufficiency of food ingested as calculated for the average child, it is natural to conclude that some impairment of nutrition follows. It must also be borne in mind that some children's expenditure of energy is far in excess of their caloric intake of food when calculated for the average child, and, therefore, unless these extra demands for additional food are fulfilled, malnutrition results.

While on the subject of malnutrition, it may not be amiss at this point to digress a moment to discuss a group of children who are labelled malnourished, but who, for all practical purposes, are healthy. These children are so mentally alert and so active physically, all of which results in the expenditure of such an enormous amount of energy, that it is practically impossible for them to replenish it, even though their appetite is ample. Although this particular group may appear at first glance malnourished, nevertheless, in a broad clinical sense, they are healthy. They are so constituted that they are able to thrive in spite of their ceaseless activity, though they may lack that reserve which is so desirable and which is to be found in the better nourished children.

Malnutrition in children may result also because the food intake lacks the necessary balance or quality. A plentiful intake of mineral salts and vitamines should always be included in the diet. More will be said about this later. Regarding balance, it is the consensus of opinion that 10 to 15 per cent of a child's diet should consist of proteins, to provide for growth and to replace the wear and tear of tissue. While it is the belief of many that fats and carbohydrates may be interchangeably utilized in the body, clinical observation bears out the fact that a goodly portion of each is necessary to insure the proper balance for digestion. Although there is a difference of opinion as to what constitutes the proper diet for a child, we cannot go far wrong if we follow the advice of Holt and of Lusk. Holt believes that one-sixth of the child's total diet should consist of protein, three-sixths or

50 per cent should be carbohydrate, and two-sixths or one-third should consist of fat. Lusk advocates that the total food intake of children should be as follows:

Boy or girl to 6 years—1500 calories
Boy or girl 6 to 10 years—2100 calories
Boy or girl 10 to 14 years—2500 calories
10 per cent allowed for waste

Utilizing these calculations as a basis for the average child, it must be borne in mind that an active or alert child requires more food than one who prefers to remain passive or quiet. Similarly, the child who is given to emotional outbreaks, or otherwise squanders energy by his temperamental characteristics, must also have a larger quantity of food. The expression "eats himself up" seems to be well adapted for such a child.

Some children thrive with a smaller amount of food than the average. Although we do not know the reason it may be stated that it is probably because their systems are very economical. On the other hand some systems are extravagant or perhaps wasteful, and if proper nutrition is to be had, they must have much more food than the average. Obviously, therefore, in calculating the food requirements for the individual child, there are many factors which must be taken into consideration.

Another common cause of malnutrition is due to physical defects. These are found during the physical examination, and should be removed, corrected, or treated as the situation demands. Sometimes, because of this treatment, the immediate results are dramatic; occasionally beneficial effects are noted later, and other times, even after the most energetic measures have been applied for these physical defects, there does not seem to be any apparent change in the child's nutrition.

The fact that children with physical defects are well nourished does not prove anything, except that physical defects may coexist in a child who is well nourished. Nevertheless, all physical defects should be taken care of as far as practical, if for no other reason than that usually they interfere with the comfort of the child, and also because there is no telling when they may act as a threat to the well-being of the individual.

It is held by some physicians that there are children who are born malnourished. This condition is sometimes called "congenital debility." Regardless of what is attempted to improve them physically, many of these children do not thrive satisfactorily. Repeated physical examinations with exhaustive laboratory investigations fail to explain why they persist in their debilitated condition. Thanks to our improved knowledge of child welfare, however, a large percentage of them survive the critical first months, and improve sufficiently in their development and nutrition to be classed as normal.

Environment is perhaps the most important factor in the causation of malnutrition in children. This, in brief, includes the child's home, of which the all important constituent is the mother. She is held responsible for the upbringing of the child, and, with few uncontrollable exceptions, if the child

is born with the average amount of physical vigor and with a normal mentality, the success or failure of the child to attain proper nutrition is due in the main to the efficiency of the mother.

What are the characteristics of an efficient mother? In good physical condition herself, she is able to withstand the routine of the household duties, which includes, of course, the bringing up of the children. She sees to it herself that she does not become exhausted or nervous. The deplorable nutritional state of many children can be traced directly to the fact that they were brought up in a household dominated by a nervous and exhausted mother. In addition to being exposed or subjected to the highly nervous tension of the home, such children are victims of their mother's mismanagement, bungling and incompetence. All this must have a detrimental effect on the children, which frequently leads to malnutrition.

Finances and equipment are secondary considerations in gauging the extent of the mother's efficiency. With few exceptions, a competent mother, in spite of obstacles, gets results with her children. Being proficient and handy, she makes the most of things to obtain her objective of raising children who are properly nourished. This is a common observation in the most congested districts where poverty is widespread, but where, thanks to the many mothers there who have an even temperament, sound judgment and common sense, a great number of children are properly nourished. On the other hand, there are many rich children who have the state of malnutrition actually forced upon them by an unfit and incompetent mother, whose vision is so warped that, so far as managing her children is concerned, she either overshoots the mark or is unable to see an inch beyond her nose.

The treatment of malnutrition in children is concerned in the main with prophylactic measures. It is much easier to prevent malnutrition than to treat it, and its prevention begins before the birth of the child. Although it does not always follow that healthy parents beget healthy children, nevertheless, it is a good working rule. Of the parents, the more important one is the mother, who should endeavor to be in good physical condition before and during the prenatal period. It has been estimated that 90 per cent or so of the babies are normal at birth and are blessed with good nutrition, and, therefore, it is logical to consider what active measures may be advocated if they are to continue so. Briefly, normal nutrition may be maintained by means of the right diet, good hygiene, avoidance of fatigue and avoidance of infection.

Since the selection of the right articles of food for the individual child is both a science and an art, it is advisable, if the best results are to be obtained, that the child be placed under the direct care of a physician. To begin with, the right diet for every newborn child is breast milk, and every attempt should be made to continue with breast feeding until the infant is eight or nine months old. For details as to what constitutes the right diet for the individual child, only generalities can be given. The suggestions of Holt and Lusk with the necessary modifications should furnish a working basis for the balance and the total calories of the child's food requirements. In addition, if a child over the age of two has a pint of milk daily, a piece of fresh fruit, two or three teaspoonfuls of cod-liver oil, one egg

and two tablespoonfuls of green vegetables, the requirements in the way of mineral salts and all the known vitamines will be amply taken care of, with a generous surplus left over as a reserve.

Time does not permit to dilate upon the known scientific data pertaining to nutrition. It is deemed worth while, however, to discuss several small but important factors bearing upon the art of feeding children. One of these concerns the "small eaters." These children cannot or will not take more than a limited quantity of food. If their food requirements are to be met, it is best to enrich their diet with butter, fats, sugars and flour, thereby concentrating the food. In this way, although a limited quantity of food may be taken, it is supplied with ample nourishment.

Food requiring mastication is a factor too frequently overlooked when planning a menu for the child. Mastication assists in the development of the jaws, thereby causing a sufficient expansion of the teeth, and to foster this, and also to promote mouth hygiene, the diet should include foods such as toast, zwieback, stale bread, bacon, fibrous fruits, vegetables, hard candies, chops, chicken bones and other foods which require chewing. Chewing releases the flavors and odors which cause a psychic and stimulating effect on the salivary and the gastric glands, thereby reacting favorably on the digestion of food in the mouth and in the intestines.

Of singular importance in the digestion of food is the favorable psychic effect produced by surroundings filled with good cheer. Efforts should be concentrated to create a bright and cheerful atmosphere at mealtime. Conversation and actions which are harmonious institute wholesome influences which, because of their psychic effect, stimulate the digestive glands and make for better digestion. On the other hand, it has been shown time and again that nagging, friction, irritation, or any discord which disturbs the mental equanimity checks, or at least greatly diminishes, the natural secretions of the digestive glands. From these disturbing influences there results impaired digestion, and hence a detrimental effect upon nutrition.

Many children suffer from nutritional disturbance needlessly because of erroneous ideas regarding special virtues attributed to certain articles of food. Through ignorance of food values many mothers defeat the purpose of the meal, simply because they insist upon the child's eating one particular article of food, while the child's preference is for a similar food with a different name. To be more explicit, there is hardly any worth while difference between foods such as cereals, rice, spaghetti, bread or rolls, or any such carbohydrate. From the point of view of nutrition, it is usually a case of "six of one and half a dozen of the other." Moreover, if a preference exists for any wholesome food, more of it is usually eaten, it is more thoroughly enjoyed, and it is more easily digested.

On the other hand, if a child has an antipathy for certain foods in their natural state, unknowingly to the child these may be served in another form: for example, when the child persists in refusing milk, the milk may be given by cooking the cereal in milk instead of in water, or in milk soups, or with some of the malted milks, or in cocoa consisting almost entirely of milk, or in

some appetizing desserts prepared with milk. If children dislike eggs, these may be conveniently fed to them in custards and in many desserts. These are merely suggestions which aim to overcome an obstacle by going around it. Similarly other foods may be camouflaged if the child's dislike for them is purely psychic.

Unfortunately, there are children who are deprived of certain foods because of some peculiar belief or prejudice of the mother. For example, sometimes children are not allowed to have carbohydrates in the form of sugars because "it is not good for them." For the same reason they are not supposed to eat meats. These prejudices would not act to the disadvantage of the child if other foods were substituted so that the total and special food requirements were fulfilled. Better nutrition for children would be maintained if the mothers were taught to identify or know foods, not by their labels, but by their actual composition.

In this country, where races are gradually assimilated, they may still be identified by their preference for those foods which are very closely associated with their mother tongue. Their desire for native dishes seems to linger with them in spite of all other adoptions. This inherent leaning toward racial foods is emphasized here because often, for one reason or another, it is ignored in planning the right diet for the individual child.

It is surprising to note the sound logic which controls the native diet. For all practical purposes the same balance and the same scientific principles are to be found in the favorite dishes of the different races. Children of some races have a great fancy for potatoes, others prefer bread and noodles, some must have their macaroni or spaghetti, others enjoy corn muffins, griddle cakes, buckwheat cakes, or similar foods which differ in name only but not in composition. All these dishes consist almost entirely of carbohydrates. To these carbohydrates as a base, other foods are added. Sometimes, to enrich and make them more palatable, additional carbohydrates are served, such as brown or white sugar, syrup and honey. Seldom are these carbohydrates eaten alone, since to them are added other foods which tend to act as a balance. For example, mineral salts in the form of eggs are introduced in some dishes; mineral salts contained in milk or cheese are mixed with other dishes. Similarly, to further complete the dish with some form of fat, butter is added to some dishes, while either cream or oil is added to others. Besides introducing valuable ingredients, these fatty foods are readily converted and utilized in the body as fats.

Since these native dishes are handed down from generation to generation, it follows that they are prepared with great diligence and care, thereby increasing their appeal to the palate. Furthermore, these are the very dishes that the child is accustomed to and desires. The excellent preparation of the food plus the craving of the child for it, are two very important considerations in producing a most desirable psychic effect which is of immense value in facilitating digestion.

The psychic response may be further intensified by several small but important details. One of these is the habit of eating at regular intervals.

Among other good qualities, this naturally creates a beneficial psychic effect which may be compared to the ready appetite which comes with hearing the twelve o'clock whistle.

At the meal table a little diplomacy and due consideration for the child's comfort result often in putting the child in a more receptive mood for food. Sometimes a child is in a happier frame of mind if he has his own small dishes and spoons. Some children like to be of some assistance at the table, and this desire may be gratified by permitting them in some small way to help prepare the food or assist in setting the table. It is also well to remember that the distance between the table and the child's chair should be of proportionate height, and that the dishes should be within easy reach. Again it may be said that these seemingly trivial details all contribute to the digestibility of the food by producing a more beneficial effect during the mealtime.

GOOD HYGIENE

Although the right diet for the individual child is the basis for good nutrition, there are other vital factors to be considered whenever proper nutrition is discussed. One of these is concerned with good hygiene. Good hygiene is a variable term, but, nevertheless, there is more or less of a general agreement as to the fundamentals. Fresh air, proper ventilation and sunshine are three very important agencies possessing great therapeutic value in the maintenance of normal nutrition. With some children the only distance between poor nutrition and normal nutrition lies in their opportunities to avail themselves of these natural gifts. Other factors concerned with good hygiene are based on common sense and circumstances, and of these, common sense usually alters circumstances so as to create situations which make for good hygiene.

Hygiene of the mind is just as important as physical hygiene. Since children do not choose their grandparents so as to assure them of a proper start mentally, it is of paramount importance to begin mental training the day the child is born. Here again common sense should prevail in carrying out this training. At the outset all detrimental influences should be eliminated or modified, because unhealthy reactions frequently result from these. Some children who have failed to adjust themselves to their environment express themselves through some such means as tantrums, emotional outbreaks, or vomiting at will. Among other detrimental influences which these may induce, is the fact that because of such wasteful expenditure of energy, there is a serious interference with the nutritional state. The child's metabolism is raised considerably during an exhibition of tantrums or other emotional outbreaks.

There is much more which may be stated for the promotion of good mental hygiene, but the two outstanding objectives which must be emphasized are robustness of character and self-reliance. These help not only to fit the child for the test of life, but also go a long way to obtain and maintain a healthy state of nutrition.

OVERFATIGUE

If there is one common denominator which may be used for malnourished children, it is overfatigue. Overfatigue and fatigue are serious obstacles to the maintenance of good nutrition. Children who are fatigued are too tired to sleep and too tired to eat. They are sometimes so exhausted that even after a night's sleep they are not refreshed sufficiently to begin the day's routine. Some of them seem to be fairly restored in the morning, but, because their reserve is so limited, they tire early in the afternoon. Naturally, their constitution functions below par, and with it, of course, their digestive apparatus.

There is a distinct individual tolerance for mental and physical endeavors. Apparently some children are supposed to possess unlimited energy, for besides their school routine, which is in many instances too great a burden for them, they are kept on the go with other activities. The desire of some parents to derive pleasure from their children's attainments is directly responsible for many children becoming malnourished. Repeatedly children are exhausted in their endeavors to overdo themselves, simply because they are urged and sometimes forced to compete with their cousins or neighbors, or to strive for some particular goal which their parents have set for them. Overfatigue is the only outcome of such excessive expenditure of efforts, and sometimes permanent harm results simply because the child's advancement mentally has been given preference to his health requirements. Added to these excessive physical endeavors is the mental strain which usually results from the fret, worry or excitement of the activities. These aggravate the situation. Occasionally mental exhaustion is merely a forerunner of physical exhaustion. It must be constantly borne in mind that the child is a growing being, and his development and growth are seriously interfered with by overfatigue. Moreover, it is felt that children who are exhausted and overfatigued are rendered much more susceptible to infection.

INFECTION

Infection is the big stumblingblock in the maintenance of normal nutrition. Here again, it is better to prevent infection than to treat it. This can best be accomplished, first, by avoiding exposure to infection, and second, by keeping the body in a state of good nutrition. Children should not be assembled in crowds, since the intimate contact and close association encourage the spread of infections. Poorly ventilated quarters and other detrimental factors such as keeping late hours, all promote conditions which are favorable for infection. It goes without saying that children should be isolated from any individual who has a cough or cold, or harbors any infection which is contagious.

There is no better equipment with which to combat infection, and more particularly chronic infections, than by the maintenance of normal nutrition. Tuberculosis is an excellent example to illustrate this fact. On the other hand, infections and malnutrition are so closely allied that very often it is not possible clinically to determine whether one or both are present. Fre-

quently malnutrition is a result of infection. In addition, it has been repeatedly demonstrated that resistance or immunity to infection is lessened or increased almost in direct ratio to the nutritional state of the individual.

Infection usually impairs the child's nutrition by lessening his desire for food. Often this symptom alone is suggestive that infection is present. Coupled with the lessening of food intake, there are other unfavorable factors at work: there is a disturbance in the assimilation of food; in addition there is generally an increase of metabolism; sometimes, there is a greater expenditure of energy since some infections cause the child to become irritable, anxious and restless. These and other similar symptoms sap the child's energy. All in all, it can be readily seen that not only are infections responsible for a reduction of the food intake, but they are also accountable for a great loss of energy.

SUMMARY

Malnutrition should be diagnosed by a physical examination. Malnutrition results from an inadequate food intake, but may also result even if the food intake is ample as a result of faulty environmental factors.

Normal nutrition, on the other hand, is the result of a combination of factors. A diet to fit the individual requirements is the basis for obtaining a normal state of nutrition. Good hygiene, which includes mental as well as physical hygiene, is an indispensable asset to maintain this normal state of nutrition. By avoidance of overfatigue and prevention of infection, much can be accomplished to safeguard the child's state of nutrition. These factors should be uppermost in the minds of all who are in any way concerned with the care of the proper nutrition of the child.

At the conclusion of the lecture Dr. Cohen showed lantern slides of malnourished children who were taken care of at the Convalescent Home for Hebrew Children, Rockaway Beach, Long Island, New York.

CHANGES IN THE HUMAN FACE BROUGHT ABOUT BY DEVELOPMENT*

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ORTHODONTIA is primarily concerned with the problem of correcting disturbances of occlusion of the human dentition. The task involved aims at a definite goal. Since faulty occlusion of the teeth is considered as a defect of the organ concerned with the function of mastication, its restoration to normal is based on physiologic needs. On this account the chief demands upon orthodontia really rest on the means employed for the successful achievement of its purpose. It is, therefore, quite natural to find the most prominent position in the realm of orthodontia occupied by those activities having a direct bearing on mechanical appliances. I am of the opinion —and few will differ with it—that the initial impulse for the world-wide recognition and for the subsequent progress of orthodontia was due to the mechanical devices and to the men who invented them. I pay my due respect to both, because I am convinced that the advances of today would be impossible without them.

In orthodontia, as in other branches of knowledge, the scientific aspect began with the observation and recognition of facts. The outstanding facts in orthodontia are: the recognition of conditions known as malocclusion of the teeth; the sorting out of these conditions into groups possessing like characteristics, classification; the discovery that malocclusion is amenable to mechanical stress; and the invention of mechanical appliances to be used for practical purposes.

The facts concerned with the advantages derived from orthodontic treatment are not quite as definite. Of course, there is in general a fourfold claim made for the benefits derived from orthodontic treatment. Three of them are physiologic; namely, the restoration to normal of the function of mastication, the improvement of the function of respiration and the correction of enunciation of certain sounds of speech. The fourth is esthetic; namely, the improvement of facial expression. Whether this fourfold claim is realized in each and every case treated, is not quite clear and depends upon the point of view of the orthodontist. Certain it is that extremely few cases reported in orthodontic literature or at professional society meetings are unaccompanied by photographs of the patient and by some sort of suggestion referring to the "improvement" of facial expression. Of course, this is perfectly justifiable; but would not such a situation be liable to lead to the inference that the facial change in those particular cases is due entirely to the orthodontist's

*Read before the First International Orthodontic Congress, New York City, August 16-20, 1926.

endeavors? And conversely, without the orthodontist no change would have taken place at all, or if so, it would have been unfavorable.

Let us face the situation squarely. A child is treated by an orthodontist for several years. The photographs taken "before and after" treatment show a very remarkable change in his physiognomy or "facial expression." This change is claimed to be due to orthodontic treatment. Are there no other factors involved in this change beside the appliances and the skill of the orthodontist? Is it possible for an orthodontist to give an adequate account of the "improvement" as being due to the treatment alone, and can he give sufficient reasons for the conviction that this "improvement" is affected by no other causes?

Such questions baffle me because I realize the fact that a child is not a finished product; he is an organism in a state of development. The process of development, it seems to me, receives little consideration and less credit for the facial changes attributed to orthodontic treatment. It, therefore, became apparent that in order to be able to understand this situation more correctly, it is necessary to establish a basis by which the changes brought about by development may be distinguished from those due to orthodontic treatment. The answer to this question assumed a larger aspect when I became impressed with the fact that no living organism is really a finished product as long as it continues to live and that man is no exception.

I then realized that in order to be able to furnish an adequate answer it was necessary to institute a systematic study of the problem of development as it affects the human face.*

At the time this decision was reached a collection of skeletal material arrived at the American Museum of Natural History, that seemed eminently fit for this purpose. This collection consists of a large number of American Indian skulls, excavated by Earl H. Morris, in Canon del Muerto, Arizona. They date back an extensive period of time, certainly more than two thousand years, and appear to have belonged to a very homogeneous group, as shown by various characters studied. This collection also recommends itself for this purpose because of its remarkable range of ages from infancy to senility; also because their dentitions are far superior to and more uniform than the dentitions of modern civilized people. The choice of this collection was made in full recognition of the fact that it does not represent mankind in detail. For that matter no single race does. What it really does do is represent a *human* type; and that is of significance. The study of this group, therefore, furnishes only a rough outline of the problem. The color and relief, so to speak, will subsequently be supplied by evidence from other sources.

The material studied consists of 78 complete skulls, 14 crania without

*There are many excellent papers written on the subject, Growth of the Face. I have studied some of them carefully and am gratefully acknowledging the valuable information gathered from them. They are all named in the references at the end of this paper. But special mention must be made of the exceptional paper on "A Contribution to the Mechanism of Growth of the Human Face," by Sir Arthur Keith and George C. Campion, published in the Dental Record, Feb., 1922, as well as the group of papers on "The Growth of the Jaws, Normal and Abnormal, in Health and Disease," published in one volume by the Dental Board of the United Kingdom.

the mandibles, 7 calvria, and 9 mandibles, in all, 108 specimens. The occlusion of the complete skulls was as follows:

Infants with deciduous dentitions:

13 normal
3 not identifiable because the molars were not yet erupted, probably normal for the age.

Children

6 normal.
1 Class II div. 2.

Youths

4 normal.
3 Class I.

Adults

9 normal, 3 Class I, and 1 Class III.
1 not identifiable.

Old

10 normal.
8 mutilated due to loss of teeth.
2 Class I.
1 not identifiable.

Senile

13 not classifiable due to various senile conditions.

Of these 65 skulls from infancy to old age inclusive, 42 dentitions, or 65 per cent are in normal occlusion. If the infantile and senile dentitions be considered as normal for infancy and senility, the percentage for normal would rise to 74. This may be considered as a very high degree of normal.

CLASSIFICATION OF MATERIAL

For the proper study of the material it had to be classified and arranged into groups. For this purpose several distinctions had to be eliminated. The first was that referring to sex differences. The reason for discarding it is because even in adult specimens sex distinctions cannot be made with unmistakable accuracy on skulls alone. But when infant skulls are studied, the distinction becomes more difficult and less accurate.

The other elimination was that of chronologic ages. There is always a great difficulty met with when chronologic ages of skeletal material are to be determined. This problem is always speculative at best, but when ancient skeletal material is concerned, it becomes a real impossibility. This is due to the fact that nothing definite is known about their environment and their reaction to it. At any rate I am not sufficiently competent to do it. I, therefore, decided to group the material in accordance with certain stages of development. This can be done more easily and more satisfactorily if the dentition is used as a basis. The development of the dentition, as you well know, bears unmistakable evidence of certain periods of life that are closely associated with the manifestation of other physiologic phenomena. These periods were determined entirely by the conditions of the dentitions, and were named stages of development. The stages of development decided upon will be referred to by the use of Roman numerals, as follows:

Stage I designates that period of early infancy before the completion of the deciduous dentition.

Stage II designates the period of late infancy at the completion of the deciduous dentition.

Stage III designates the period of childhood, when the permanent first molars are erupting or have taken their positions, in addition to which some or all of the deciduous incisors have been lost and are replaced by their permanent successors.

Stage IV designates the period of pubescence, when the second permanent molars are erupting or have taken their positions, in addition to which some or all of the deciduous canines and molars are lost and are being replaced by their permanent successors.

Stage V designates the period of adulthood when the third molars are erupting or have taken their position.

Stage VI designates the period of old age when the occlusal surfaces of the molars are worn off to the extent of obliterating the pattern of grooves.

Stage VII designates the period of senility, when at least half of the crowns of the teeth are worn off, in addition to which some, most, or all of the teeth have been lost.

The distinctions of the stages I, II, III, IV, and V can be applied to the dentitions of any race, while those of stages VI and VII refer mostly to those races whose food is intermingled with gritty substances, on account of which they show considerable wear of the teeth with age. The American Indian and Australian aboriginals are peculiarly subject to such wear. Among civilized white people the last two stages as presented by the teeth of the American Indian, can hardly be observed. In the further elaboration of this paper the numerals alone will be used, but it is to be understood that they indicate these stages of development.

By the adoption of this classification the difficulty of the chronologic age was eliminated and definite landmarks in development established. It must be admitted that chronologic ages and stages of development are only remotely related, because certain stages in development are reached by some individuals much earlier than by others. As a consequence, the age at which a stage in development is reached varies considerably when large numbers of individuals are concerned, but the stage attained is nevertheless the same in all. For example, all children in the course of development go through the stage of puberty before they become adults; but some go through it earlier, others later. This depends on hereditary tendencies, on environmental influences, and on many other known and unknown conditions. Similarly, all children will erupt a certain tooth, but this too will depend on different conditions. The fact of erupting such a tooth will, however, indicate a definite stage in the development of that dentition.

The significance of the variability in the eruption of teeth has been extensively discussed by Boas, Wissler, Spier, Hellman, Suk and Gebhard. In a general way they all point to the fact that the eruption of teeth is a physiologic phenomenon, indicating certain stages of development.

In the living some of the stages of development may be translated into

terms of years. For instance, the records of 392 New York individuals were sorted out in the same manner as the skeletal material above. An estimate was then made of their chronologic ages. The result was as follows:

STAGE	NUMBER	AVERAGE AGE	STANDARD DEVIATION
I	none	—	—
II males and females	13	6.00 years	1.13 years
III males	85	9.98 years	1.76 years
females	89	9.80 years	1.66 years
IV males	74	14.98 years	1.76 years
females	121	14.44 years	2.00 years
V females	11	22.45 years	1.83 years

This gives an approximate estimate, or rather a rough idea of the periods of time covered by the stages of development, as outlined above. It also shows that the elimination of sex differences matters little, because even in this more extensive material they disappear when similarly dealt with, as was done in stages III and IV.

DEVELOPMENT

Before discussing development as it concerns the human face, it would be of advantage to recall some generalizations derived from biology. Many people usually assume that development is just spatial enlargement. The born mammal, the hatched bird or fish appears to the average person as a small reproduction that just needs enlargement to become an adult. The illustrations accompanying various articles on growth of the face or jaws betray a tendency of this sort, especially when a skull of an infant is compared with that of an adult. Even among some of those who know better this attitude is not entirely overcome. This, however, is not development. The process of attaining the adult stage is not quite so simple. If we compare, for example, the egg with the hen there will be found no resemblance between them at all. The egg is spherical and increasing its size would not make a hen of it. Something else is necessary to change the sphere into the hen. This something is accomplished by the process of molding or changing of form which transforms the simple sphere into a complex hen. Development, therefore, is more than a single process. It is a single term meaning many processes. The processes designating development fall naturally into two groups; one is concerned with increase in size, the other with increase in complexity of structure and form. The name for the processes concerned with change in size is *growth;* that of the other, *differentiation.* Growth and differentiation therefore affect the life cycle of all organisms from the fertilization of the ovum to senility.

It must be further emphasized that these processes although independent in many respects, are nevertheless subserving one another's purpose. For instance, in order to obtain a change in form all that is necessary is for growth to be more rapid in some direction than in another. Thus differentiation in form or *morphologic differentiation* is simply a peculiar kind of growth, affecting the form of the organism. There is also another kind of differentiation. In the development of an organism, the beginning is made with the fertilized

egg. All cells at first derived from the egg are alike. But some of them are later changed into brain substance, muscle tissue, bone structure, etc., for the purpose of performing special tasks for the needs of the organism as a whole. The change of the simple generalized cells into specialized structures constitutes *histologic differentiation.*

We thus have two kinds of differentiation: *histologic differentiation;* i.e., differentiation of cells into the tissues which they make up, and *morphologic differentiation,* the process of molding and increasing the complexity of the entire form of the organism. Of course, this study is concerned mainly with morphologic differentiation.

Growth too is brought about in several ways. Thus, growth may be due to an increase in size of the cells or to an increase in the number of cells, their size remaining the same. This kind of growth is really due to an increase in *living* substances. But increase in size may also be brought about by an increase in other *nonliving* substances. Yolk, for instance, being stored up inside the egg increases its size. Another instance of growth of particular interest to us is the accumulation of the inorganic salts constituting bone. In this instance the deposit is outside and between the cells making up intercellular substances. Also the absorption of water increases the size by swelling up the organism. But this is of no interest to us now.

Again, while not contributing to the growth of the organism, differentiation of tissues may produce increase in size of certain structures. Bones, for instance, increase in size as they continue to differentiate. But the addition of bone substance in one place is often accompanied by its removal in another. There is thus an adjustment of form often bringing about a change in proportion. In the long bones, for instance, as bone is deposited on the surface of the shaft, it is removed in the marrow cavity. The jaw bones, too, present an illustrative example of this kind. The experiments on pigs fed with madder, mentioned in the paper by Brash, well emphasize this fact. Then, too, as the maxilla increases in size, the nasal aperture and the maxillary sinus become larger. This is no doubt brought about by the same regulating process.

The fundamental fact to be remembered is that "only those tissues of a sufficiently low degree of differentiation are capable of growing" (DeBeer). There are many special centers of growth in plants, animals and man that persist throughout life. They all consist of tissues of a low degree of differentiation and are capable of growing throughout life. The hair follicles in man from which the hair continues to grow throughout life is an example of this kind. The dental papilla, though of much shorter duration, is another. According to recent observations (Todd) bone continues to differentiate until senility. This may lead to the inference that bone cells too are of a low degree of differentiation because they do continue their bone constructing ability throughout life. This is further emphasized by the fact—the evidence for which will be furnished herewith, that the skeletal structure of the human face does not remain the same, but continues to change as long as life lasts.

THE RATE OF GROWTH

These biologic facts should suffice to convey a general idea of the qualitative aspect of development. Let us now inquire into the relation which development bears to certain standards of measurement. In other words, even if an adequate understanding is gained of the process of development, how can it be measured? Since development consists of growth and differentiation and since differentiation is a peculiar kind of growth, it seems that the task is not insuperable. The biologist takes recourse to weight, because in all organisms weight is a function of size and increase in size is what really constitutes growth. Therefore, the greater the size of the organism, the heavier it will be. If it is desired to know how much growth has taken place in how long a time, all that is neecssary to do is to obtain the weight at different time intervals and the answer is furnished.

The face of man, however, cannot be weighed. Is there no other way of measuring it? If we substitute the measurement of size for that of weight like results may be obtained. This, however, is not so simple. The measurement of weight secures the quantity of bulk. Size can only be measured in one direction. In order to obtain an estimate of bulk it is necessary to obtain measurements in three directions; namely, height (or length) width and depth of the same organism or structure. The study in development of the human face, therefore, had to be pursued on this basis. But these measurements had to be considered also in relation to time. It is on this account that the stages of development outlined above had to be adopted so as to be able to estimate what changes occur from stage to stage.

MEASUREMENTS

As stated above, in order to gain an idea of bulk, the quantitative analysis of the face had to be made by means of three sets of measurements; namely, of height (length), of width, and of depth. For this purpose the landmarks used in anthropology were employed. But when these alone did not suffice, others had to be supplemented. The measurements are:

A.—Measurement of Height of Face:

(a) Total face height, from the point where the nasal bones articulate with the frontal bone (nasion) to the lower border of mandible in the median plane (menton).

(b) Upper face height, from nasion to lowest interalveolar point of the bony septum between the upper central incisors (upper alveolar point).

(c) Lower face height (symphysial height) from highest point of interalveolar septum between the lower central incisors (lower alveolar point) to the menton.

(d) Dental height or interalveolar distance from the lowest point of interalveolar septum between the upper central incisors to highest point of interalveolar septum between lower central incisors.

(e) Anterior nasal height, from nasion to the lowest point of the anterior margin of the floor of the nose.

(f) Posterior nares height, from base of vomer to the posterior margin of the palatal process of the palate bone.

(g) Subnasal height, from anterior margin of the floor of the nose to the upper interalveolar point.

(h) Palate height, from a line at the top of the interalveolar septum between second and third molars on both sides to the highest point of the palate in the median line. (For this measurement a special instrument had to be devised because this point had to be ascertained from three planes—anteroposteriorly, transversely and vertically.)

(i) Mandibular height, from the point of the interalveolar septum between first and second molars to the lower border of body of mandible held in a horizontal plane.

(j) Ramus height*—

(1) Condylar height, from the angle of jaw (gonion) to highest point of condyle.

(2) Coronoid height, from the gonion to the tip of the coronoid process.

(k) Sigmoid notch depth, from a line touching the highest points of the condyle and coronoid process to the deepest point in the curve of the notch.

B.—Measurements of Width of Face:

(a) Interorbital, between the points of articulation of frontal, maxillary and lacrymal bones (acanthion).

(b) Bimalar, between the maxillo malar suture at the lowest point.

(c) Bizygomatic, between the zygomata at their widest spread.

(d) Nasal width, between the lateral margins of the nasal aperture at their widest points.

(e) Posterior nares, between the posterior margins of the internal pterygoid plates about one-third above the palate.

(f) Bicanine (minimum alveolar arch width), (1) between the most prominent facial points of the canine alveoli, in the maxilla, and (2) at the most prominent point between the canine and first premolar in the mandible.

(g) Minimum palate, between the palatal margins of canine alveoli.

(h) Maximum palate, between the alveolar margin distally to the second molar.

(i) Maximum upper alveolar arch width, between the widest spread on the buccal side of the alveolar process.

(j) Maximum lower alveolar arch width, same as above.

(k) Condylar, between the external extremities of condyles.

(l) Gonial, between the angles of the mandible.

C.—Measurements of Depth of Face:

(a) Total palate depth, from anterior margin of anterior palatine fossa to a transverse line on the palate plate of palate bone indicating the nearest points of the posterior border.

(b) Anterior palate depth of maxilla from the same anterior point to the transverse suture of the palatal processes of the maxilla and the palate bones.

(c) Posterior palate depth, the width of the palate process of the palate bone.

(d) Upper alveolar arch, from the labial surfaces of the alveoli of upper central incisors (posthion superior) to a transverse line behind the last molars.

(e) Lower alveolar arch, same as above.

(f) Total mandibular depth, (1) Occlusal, from labial surface of alveolar process of central incisors (prosthion inferior) to posterior margin of ramus in the same plane. (2) Basal, from anterior most prominent point on the chin to the gonion.

D.—Measurements of Angles:

(a) Facial angle, taken on a craniostat, placed on a horizontal base, by means of the "Ansteck goniometer," the points of the calipers being placed at the nasion and upper prosthion.

(b) Alveolar angle, taken the same way, the points of the calipers being separated one cm. and placed on the facial surface of the alveoli of one of the upper central incisors.

(c) Gonial angle, taken with the goniometer mentioned above.

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*For these measurements the mandible was adjusted on a goniometer made for me by Prof. Todd. This instrument allows the adjustment of the mandible between two planes united by a hinge. One plane formed the base upon which the body of the mandible rested—the other is brought into apposition to the posterior border of the ramus. The measurements were taken from the angle formed by these two planes.

(d) Mentr' angle, taken the same way as the alveolar angle—the mandible in this instance being placed on the horizontal base; the points of the caliper being placed on the most prominent point of the chin and below the alveolar process in the median plane.

There were at least 70 measurements of each skull necessary for this purpose. If we multiply 70 by 78, the number of complete skulls constituting just the nucleus of this study, the number of measurements will be 5460. This, however, is just a fraction of the actual labor entailed in measuring alone. The conclusions arrived at in this paper are based on similar records with more measurements of at least 500 skulls of different races and of 500 living individuals. I am mentioning this to give you an approximate idea of the labor involved in a study of this kind and the time necessary to perform it. But the work does not end here. The calculations and the classification of the recorded facts is also labor involving time. Just think it over and let it go at that.

THE FACTS REVEALED BY THE MEASUREMENTS

A.—*Measurements of Face Height.*

What do these measurements show? They show a good deal. Examine for instance, Table I. This table represents the measurements of the total height of the face, taken from nasion to menton. But besides giving the height of the face, there are many other facts recorded on it.

First, it gives the stages of development when the measurements were taken (column 1). Second, it gives the number of individual specimens belonging to each group (column 2). Third, it gives the mean (average) in mm. of each group of measurements (column 3). Fourth, it gives the standard deviation or range of variability of the individuals within the group (column 4). Fifth, it gives the difference in mm. between a certain group and the one preceding it. Last, it expresses the differences—increase or decrease—in per cent. While it is a very simple matter to note that these figures point to certain changes taking place from stage to stage, it is not quite so simple to note just what they are. The last column helps to clear up this matter and point out just how these changes occur. The reason for expressing growth changes in per cent is consequently obvious. A tall individual, for example, adding one cm. to his stature in a given time will be growing slower than a short one adding the same height in the same length of time. The percentage additions therefore give the relative rate of growth in a given interval of time. The percentage additions are obtained by taking the additions in dimension occurring during an interval of time, and expressing it as percentage of the total dimensions of the part measured at the beginning of that interval of time. The percentage increases and decreases in this study were worked out in the same way, but the figures used were those of the means (averages) and the differences between the means of consecutive stages. It is, therefore, quite convenient and very profitable to have this column appended to any table presenting measurements of growth. It helps to illustrate what has happened or is happening at a glance. For example, following the sixth column down, it is seen that from I to II, 17 per cent has been added to the total height of the face. In the next stage another addition is

made, but this one is less than the previous one. The third addition of 24 per cent is the largest increase in face-height. Then follow two more additions, one smaller than the other. The final figure then shows an actual decrease. There are then several important facts recorded in this column.

1. The height of the face increases as the individual passes on from stage to stage in the course of time until old age is reached, after which there is a decrease in height taking place during senility.

2. This process of development is accompanied by accelerations and retardations in the rate of growth. There is an acceleration of growth during the period of late infancy (I to II), which is followed by a period of retardation during childhood (II to III). In other words, the total face height increases more during the interval between stages I and II than it does during

TABLE I

SHOWING CHANGES IN DIMENSIONS OF TOTAL FACE HEIGHT AT THE DIFFERENT STAGES OF DEVELOPMENT

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE	PERCENTAGE INCREMENT SUPERPOSED
I	7	66.27	3.42	—	—	—
II	9	77.80	6.30	11.53	17	
III	6	88.35	6.85	10.47	14	31
IV	6	110.00	6.45	21.53	24	55
V	13	116.90	9.70	6.90	6	61
VI	20	121.00	6.70	5.10	4	65
VII	13	108.10	5.55	–12.90	–11	54

TABLE II

SHOWING CHANGES IN DIMENSIONS OF UPPER FACE, NASION TO ALVEOLAR POINT (SEE MEASUREMENTS IN TEXT)

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	41.13	3.48	—	—
II	10	47.90	3.57	6.77	12
III	9	53.34	3.51	5.44	11
IV	10	65.50	4.08	12.90	24
V	17	72.05	5.00	6.55	10
VI	23	73.25	4.80	1.20	2
VII	13	69.25	4.75	– 4.00	– 6

TABLE III

SHOWING CHANGES IN DIMENSIONS OF LOWER FACE HEIGHT (SYMPHYSIAL HEIGHT)

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	11	19.09	1.73	—	—
II	12	22.08	1.16	2.99	16
III	7	24.00	0.93	1.92	9
IV	7	29.87	2.64	5.87	25
V	15	34.00	3.45	4.13	14
VI	21	34.56	3.03	0.56	2
VII	14	32.37	3.42	– 2.19	– 6

the next following it. A second and most pronounced acceleration then sets in again during the period preceding puberty (III to IV), to be followed by a gradual retardation in rate of growth until senility.

3. In senility actual decrement or degrowth occurs.

These facts are borne out again and again when the development of any living organism or structure is studied. Tables I to XII inclusive bear the evidence for this statement with reference to the development of the face in height. They may be studied with benefit. Another way of emphasizing these facts is by means of graphs. If we plot the percentage against time we get a curve that indicates the *percentage addition* of growth. The conventional form of plotting percentage additions, assumes a form which, in my estimation, fails to convey the idea I have in mind. I have, therefore, digressed from the conventional custom and constructed a graph by adding

TABLE IV

SHOWING CHANGES IN DIMENSIONS OF INTERALVEOLAR DISTANCE (DENTAL HEIGHT)

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	6.86	1.55	—	—
II	9	10.56	1.26	3.70	54
III	6	13.00	2.24	2.44	23
IV	6	13.50	1.26	0.50	4
V	13	13.31	1.38	- 0.19	- 1
VI	21	11.86	2.70	- 1.45	-11
VII	13	6.31	2.67	- 5.55	-47

TABLE V

SHOWING CHANGES IN DIMENSIONS OF NASAL HEIGHT

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	31.13	2.64	—	—
II	10	33.50	2.43	2.37	8
III	9	38.01	2.43	4.51	14
IV	10	45.90	3.03	7.89	21
V	18	48.90	4.80	3.00	7
VI	23	50.20	4.05	1.30	3
VII	13	48.77	2.12	- 1.43	- 3

TABLE VI

SHOWING CHANGES IN DIMENSIONS OF POSTERIOR NARES HEIGHT

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	6	16.33	1.37	—	—
II	9	19.56	2.06	3.23	20
III	9	20.78	0.79	1.22	6
IV	9	25.00	1.41	4.22	20
V	15	26.60	1.95	1.60	6
VI	22	26.77	2.34	0.17	1
VII	11	25.91	1.38	- 0.86	- 3

Percentage Addition and Reduction
of Total Face Height and
Its Component Parts

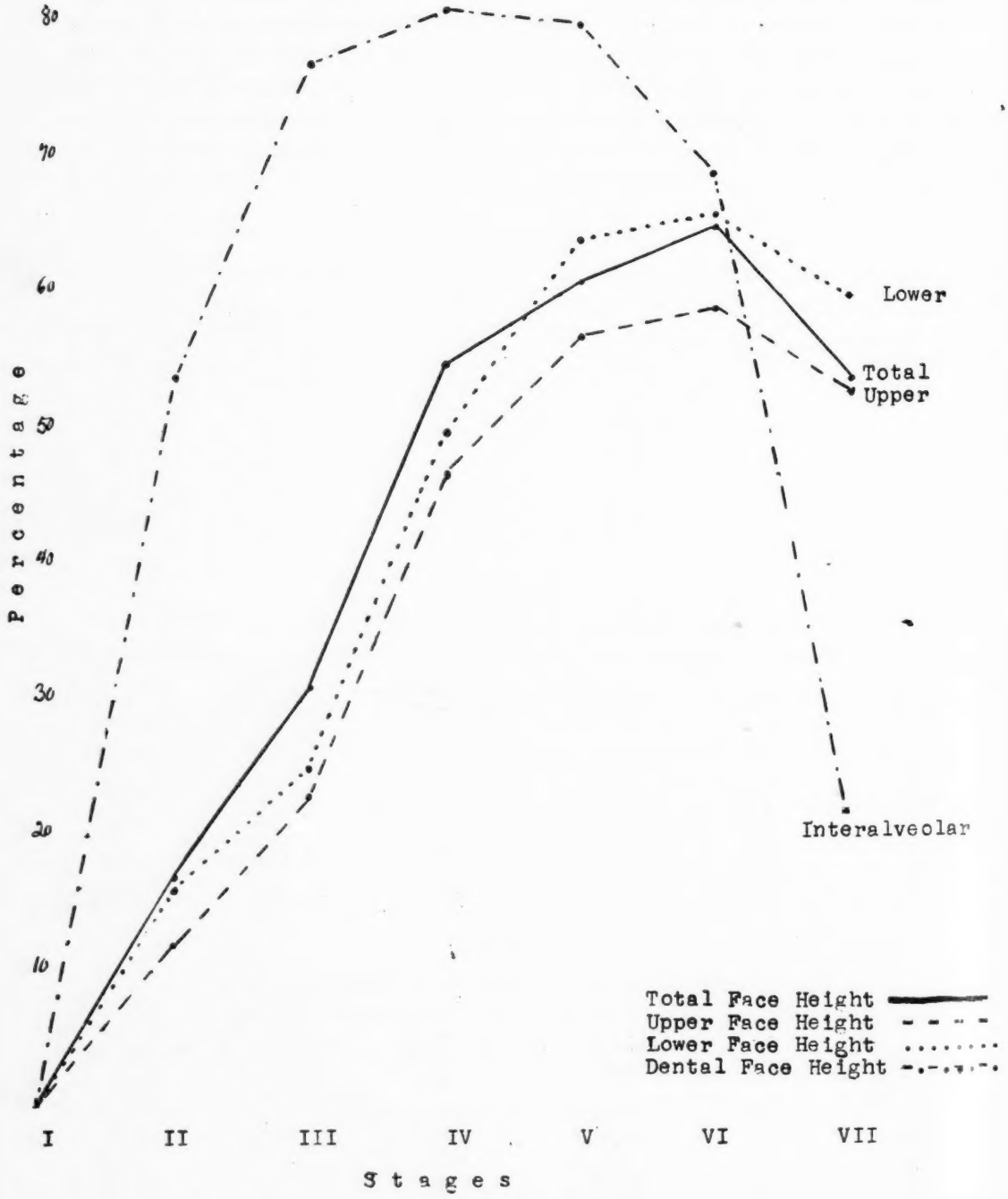

Fig. 1.

on or superposing the percentage additions, column 7, Table I, to each other as the organic structure continues to grow, instead of plotting each percentage increment from the base line. Fig. 1, solid line, gives the growth curve of the total face. This is accompanied by curves worked out from the

TABLE VII

SHOWING CHANGES IN DIMENSIONS OF SUBNASAL HEIGHT

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	10.49	0.50	—	—
II	10	14.40	2.11	3.91	37
III	9	15.78	2.20	1.38	10
IV	10	19.90	2.70	4.12	26
V	16	22.11	3.06	2.21	11
VI	23	23.05	2.88	0.94	4
VII	13	20.00	3.12	− 3.05	−13

TABLE VIII

SHOWING CHANGES IN DIMENSIONS OF PALATE HEIGHT

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	6	4.33	1.10	—	—
II	10	5.20	0.98	0.87	20
III	9	7.11	1.28	1.91	37
IV	11	11.35	2.97	4.24	60
V	17	14.41	1.57	3.16	28
VI	22	14.50	2.82	0.09	1
VII	11	10.75	3.24	− 3.75	−26

TABLE IX

SHOWING CHANGES IN DIMENSIONS OF BODY OF MANDIBLE DISTAL TO FIRST MOLAR IN HEIGHT

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	10	14.30	0.78	—	—
II	11	16.27	1.13	1.97	14
III	7	19.29	1.75	3.02	19
IV	7	24.00	2.04	4.71	24
V	15	29.67	2.33	5.67	22
VI	21	29.29	3.03	− 0.38	− 1
VII	13	25.24	4.17	− 4.05	−14

TABLE X

SHOWING THE CHANGES IN DIMENSIONS OF RAMUS IN HEIGHT FROM GONION TO CONDYLE

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	11	28.00	2.22	—	—
II	11	35.46	3.18	7.46	27
III	8	44.00	2.10	8.54	24
IV	6	53.50	3.78	9.50	22
V	15	60.41	4.65	6.91	13
VI	21	62.40	5.60	1.99	3
VII	14	61.75	5.20	− 0.65	− 1

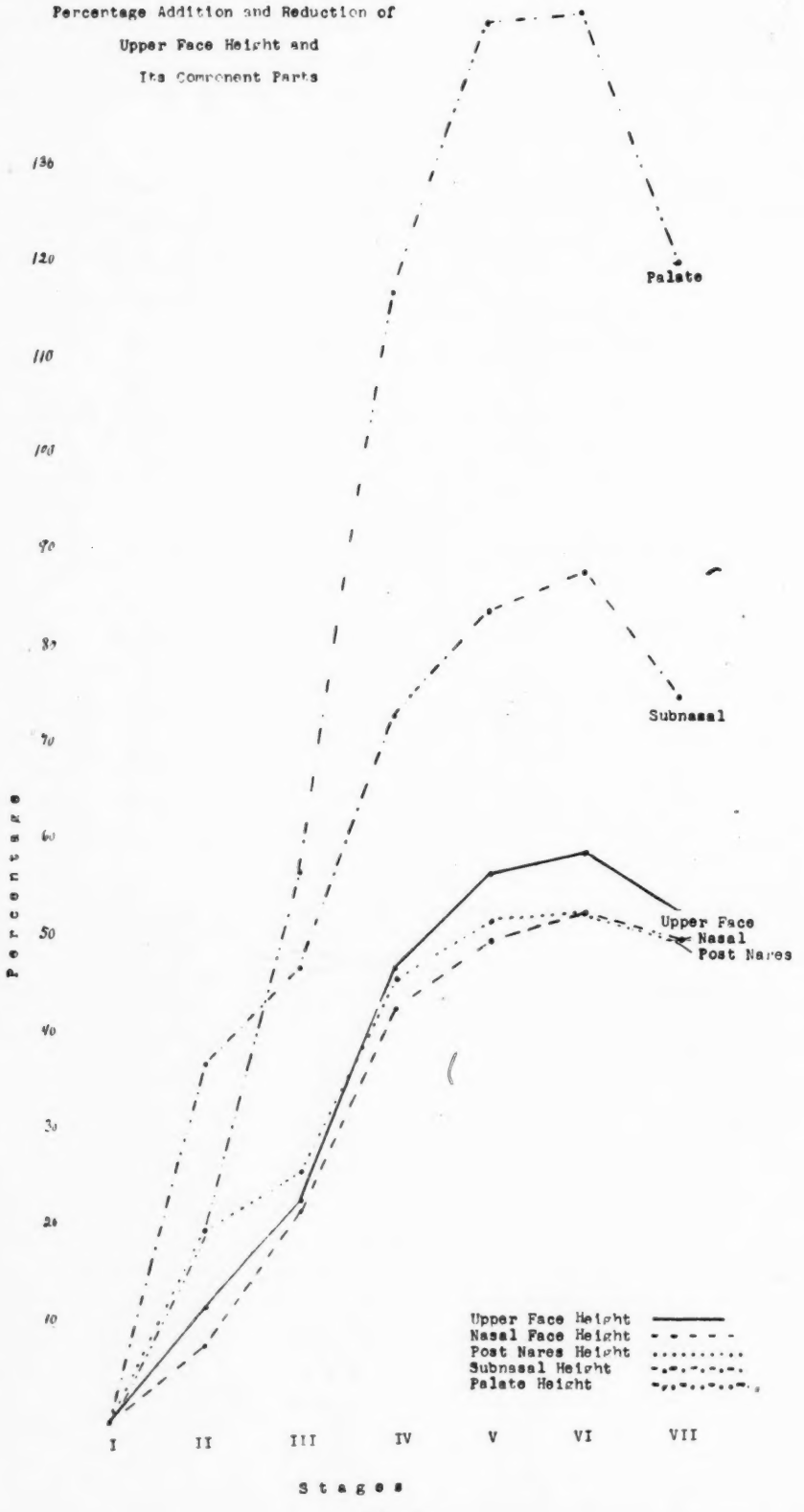
Percentage Addition and Reduction of
Upper Face Height and
Its Component Parts
Palate
Subnasal
Upper Face
Nasal
Post Nares
Upper Face Height
Nasal Face Height
Post Nares Height
Subnasal Height
Palate Height
Percentage
I
II
III
IV
V
VI
VII
Stages

Fig. 2.

TABLE XI

SHOWING CHANGES IN DIMENSIONS OF RAMUS IN HEIGHT FROM GONION TO TIP OF CORONOID PROCESS

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	8	28.75	1.20	—	—
II	11	35.08	2.31	6.33	22
III	8	44.63	2.28	9.55	27
IV	7	55.42	2.97	10.79	24
V	15	62.41	5.88	6.99	13
VI	21	64.80	5.64	2.39	4
VII	14	62.78	4.14	− 2.02	− 3

tables for growth in its component parts, the upper face, lower face and interalveolar distance or dental height. (See measurements.)

This graph is an instructive illustration of the process of development. It shows how the total face height keeps on increasing in dimension at a higher rate (solid line) despite the lower rate of increase of both the upper and lower face height. This is due to the rapid increase in the dental height during the early stages of development when the face grows more slowly. But the dental height begins to decline earlier (IV), while the face height keeps on gaining for a longer time. Both upper and lower curves keep on rising, that of the lower face more than the upper, until old age (VI). The total face then diminishes in height more rapidly than either upper or lower because of the excessive decline of the dental height in senility.

Just as valuable a lesson may be learned from the graphs (Fig. 2), illustrating growth changes in height of upper face, of anterior nasal height and posterior nares, of subnasal area and palate vault. The general fundamental facts noted in the development of the total face in respect to increase and decrease in height, periods of acceleration and retardation in growth are again manifest in this illustration. But of additional interest in this graph is the difference in the rate of growth between the nasal and subnasal areas. Both the palate height and the alveolar process grow considerably more exuberantly. Another interesting feature is the rapid and earlier growth at first (I-II) of the subnasal area, exceeding all other parts and the very slow rate of development of the nasal area during the same period (I-II). Then the abrupt retardation (II-III) of the former, followed again by rapid growth to old age (VI), which terminates in a marked decrease in senility. Associated with this is the steady increase in palate height exceeding all other growth curves, while the growth of the nasal areas are all the way below that of the upper face curve. The nose, according to this evidence, develops more slowly than any other feature of the face.

Fig. 3 illustrates the manner of growth of the different areas of the mandible. In general the curves in this figure show that the mandible grows more rapidly in height than does the upper face. It also shows that in the symphysial region the mandible grows less rapid and decreases more than in any of its other areas, excepting the decrease in the molar region.

The curves of all other growing areas are considerably above that of

Percentage Addition and Reduction in
Measurement of Lower Face Height
and Its Allied Parts

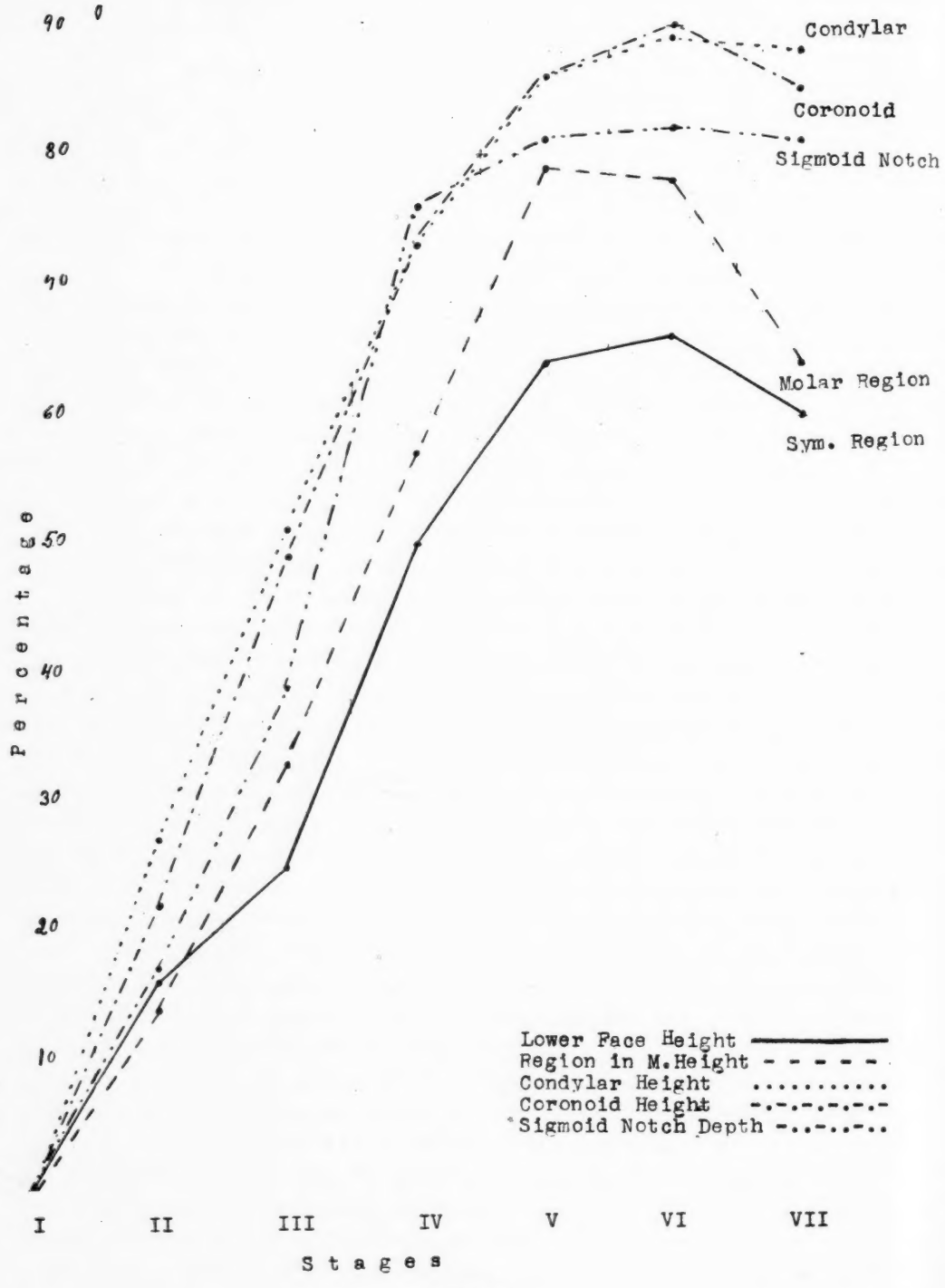

Fig. 3.

the symphysis. One interesting peculiarity is the decline in old age (VI) instead of senility (VII) of the mandibular height (first molar region). The coronoid and condylar heights and the depth of the sigmoid notch on the contrary decline very little.

TABLE XII

SHOWING CHANGES IN DIMENSIONS OF SIGMOID NOTCH IN HEIGHT (DEPTH)

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	8	6.25	0.66	—	—
II	10	7.30	1.27	1.05	17
III	8	8.87	1.17	1.57	22
IV	6	12.17	1.77	3.30	37
V	15	12.80	1.33	0.63	5
VI	21	12.90	1.43	0.10	1
VII	14	12.79	2.07	− 0.11	− 1

TABLE XIII

SHOWING CHANGES IN DIMENSIONS OF WIDTH OF FACE BETWEEN THE ZYGOMATA

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	8	83.75	3.27	—	—
II	9	93.67	3.87	9.92	12
III	12	104.25	3.03	10.58	11
IV	10	123.50	5.00	19.25	18
V	17	129.54	6.03	6.04	5
VI	21	135.00	7.70	5.46	4
VII	13	131.55	4.95	− 3.45	− 3

TABLE XIV

SHOWING CHANGES IN DIMENSIONS BETWEEN THE MAXILLOMOLAR SUTURES

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	6	65.99	2.82	—	—
II	9	72.68	4.05	6.69	10
III	10	82.50	4.60	9.82	13
IV	11	93.20	6.85	10.70	13
V	18	98.60	5.50	5.40	6
VI	23	102.15	5.85	3.55	4
VII	13	101.15	6.55	− 1.00	− 1

TABLE XV

SHOWING CHANGES IN DIMENSIONS OF MINIMUM MAXILLARY ALVEOLAR ARCH WIDTH (BICANINE WIDTH)

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	32.71	1.39	—	—
II	10	31.20	1.78	− 1.51	− 4
III	10	33.50	1.57	2.30	+ 7
IV	11	38.81	2.88	5.31	+16
V	17	39.87	2.22	1.06	+ 3
VI	23	40.71	3.54	0.84	+ 2
VII	12	36.74	3.96	− 3.97	−10

These, then, are the changes in height of the face brought about by development. They are increases and decreases in dimension subject to periods of time. But while growth occurs throughout the entire extent of

TABLE XVI

SHOWING CHANGES IN DIMENSIONS OF WIDTH OF ANTERIOR NASAL APERTURE

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	18.43	1.29	—	—
II	10	19.70	1.01	1.27	7
III	10	21.90	1.14	2.20	11
IV	11	24.75	1.91	2.85	13
V	18	26.00	1.73	1.25	5
VI	23	26.26	1.48	0.26	1
VII	13	26.00	1.18	− 0.26	− 1

TABLE XVII

SHOWING CHANGES IN DIMENSIONS OF INTERORBITAL WIDTH AT DACRYON

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	9	15.89	1.10	—	—
II	9	17.67	0.94	1.78	11
III	12	18.00	1.53	0.37	2
IV	10	21.40	1.20	3.40	19
V	20	21.80	1.86	0.40	2
VI	23	22.47	1.62	0.67	3
VII	12	22.50	1.44	0.03	0.1

TABLE XVIII

SHOWING CHANGES IN DIMENSIONS OF POST NARES WIDTH AT UPPER THIRD OF MARGIN OF INNER PLATES OF PTERYGOID PROCESSES

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	6	23.17	1.20	—	—
II	9	23.00	1.49	− 0.17	− 1
III	10	26.60	1.50	3.60	+15
IV	9	29.67	3.30	3.07	+12
V	16	30.82	2.25	1.15	+ 4
VI	20	30.80	2.40	− 0.02	− 0.1
VII	11	29.55	2.19	− 1.25	− 4

TABLE XIX

SHOWING CHANGES IN DIMENSIONS OF MINIMUM WIDTH OF PALATE BETWEEN GINGIVAL MARGINS OF CANINE TOOTH SOCKETS

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	20.71	0.88	—	—
II	8	23.25	1.56	2.54	12
III	9	26.11	1.29	2.86	12
IV	9	26.11	2.03	—	—
V	17	27.29	1.77	1.18	5
VI	22	26.96	2.10	−0.33	− 1
VII	11	24.65	2.34	−2.31	− 9

the face, there is more exuberant growth in the oral region than above or below it. The face thus gains in height in two ways,—(1) by actual increment, and (2) by a sort of wedging apart of the extremes, upper and lower portions, by the more rapid growth of the teeth and their supporting struc-

TABLE XX

SHOWING CHANGES IN MAXIMUM WIDTH OF PALATE AT SECOND MOLAR REGION (SEE MEASUREMENTS)

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	26.13	2.64	—	—
II	10	29.30	3.00	3.17	12
III	9	34.68	2.85	5.38	18
IV	11	39.08	2.31	4.40	13
V	17	42.53	1.98	3.45	8
VI	23	42.27	3.42	−0.26	− 1
VII	12	41.25	2.16	−1.02	− 2

TABLE XXI

SHOWING CHANGES IN DIMENSIONS IN MAXIMUM WIDTH OF MAXILLARY ALVEOLAR ARCH

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	6	45.00	1.53	—	—
II	10	48.80	2.04	3.80	8
III	11	57.73	2.42	8.93	18
IV	10	63.20	3.60	5.47	10
V	15	63.93	2.46	0.73	1
VI	17	63.18	3.33	−0.75	− 1
VII	11	58.20	8.30	−4.98	− 8

TABLE XXII

SHOWING CHANGES IN DIMENSIONS OF BYCONDYLAR WIDTH

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	10	74.80	2.32	—	—
II	11	83.19	4.62	8.39	11
III	7	95.70	6.20	12.51	15
IV	6	108.30	10.70	12.60	13
V	14	115.35	4.80	7.05	7
VI	19	118.70	6.85	3.35	2
VII	14	119.05	7.10	0.35	0.3

TABLE XXIII

SHOWING CHANGES IN DIMENSIONS OF BIGONIAL WIDTH

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	10	61.40	2.51	—	—
II	11	67.19	5.28	5.79	9
III	7	75.00	4.23	7.81	12
IV	7	92.29	4.37	17.29	23
V	14	94.65	5.15	2.36	3
VI	19	95.55	7.25	0.90	1
VII	14	96.21	5.10	0.66	1

tures. The face also grows rapidly in height during the interval between Stages I and II, slowing up from II to III, then speeding up again from III to IV, exceeding the rapid rate of before. Then follows a gradual diminution in the rate to VI, to be followed by an actual decrease at VII.

B.—*Measurements of Face Width.*

The process of development affecting the face dimensions in height at the same time also brings about their widening. The manner in which the face widens is in a general way quite like that followed when it lengthens or

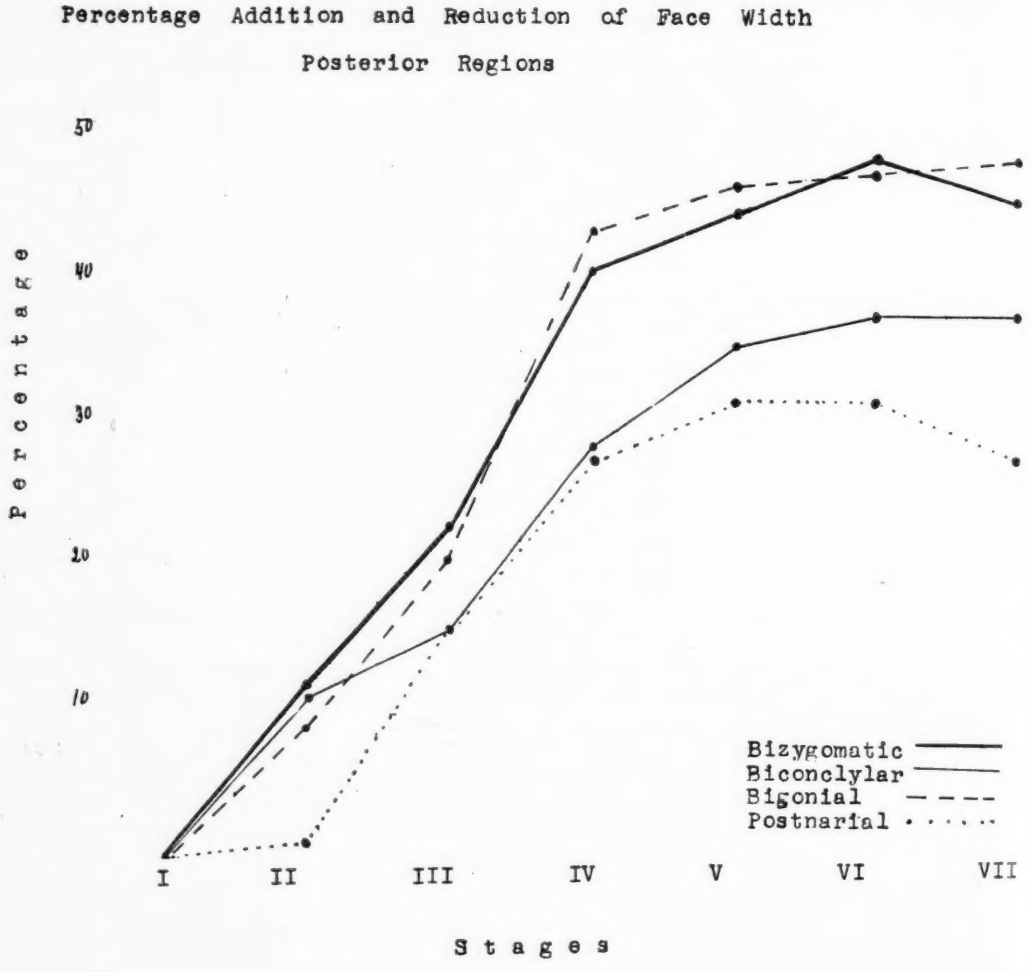

Fig. 4.

rather heightens. Tables XIII to XXV inclusive, clearly show the same general tendency of growth. The percentage additions and reductions are not so very much unlike those witnessed in the development in height. The accelerations and retardations of the changes in width appear at approximately the same stages of development as those in height.

The illustrations, Figs. 4 to 8, however, present a better picture of *how* and *when* these changes involved do take place.

Fig. 4 presents the changes in width of regions in a related coronal plane. The illustration shows that these regions situated furthest from the

median, sagittal, plane widen most. Thus the bizygomatic and bigonial widths show the highest percentage of widening. The bicondylar being more internal widens less, while the posterior nareal widens least. There are two interesting features appearing in this illustration that have not been noticed before. One is the absence of a decrease in the bicondylar width after the stage of old age (VI), and the other is the actual increase in the bigonial width from Stage VI to VII. This shows that bone growth does occur even in senility. The mandible is the best illustrative example of it.

Fig. 6 has some other points of interest in this connection. In its general aspect it illustrates the same fundamental changes of growth; but it

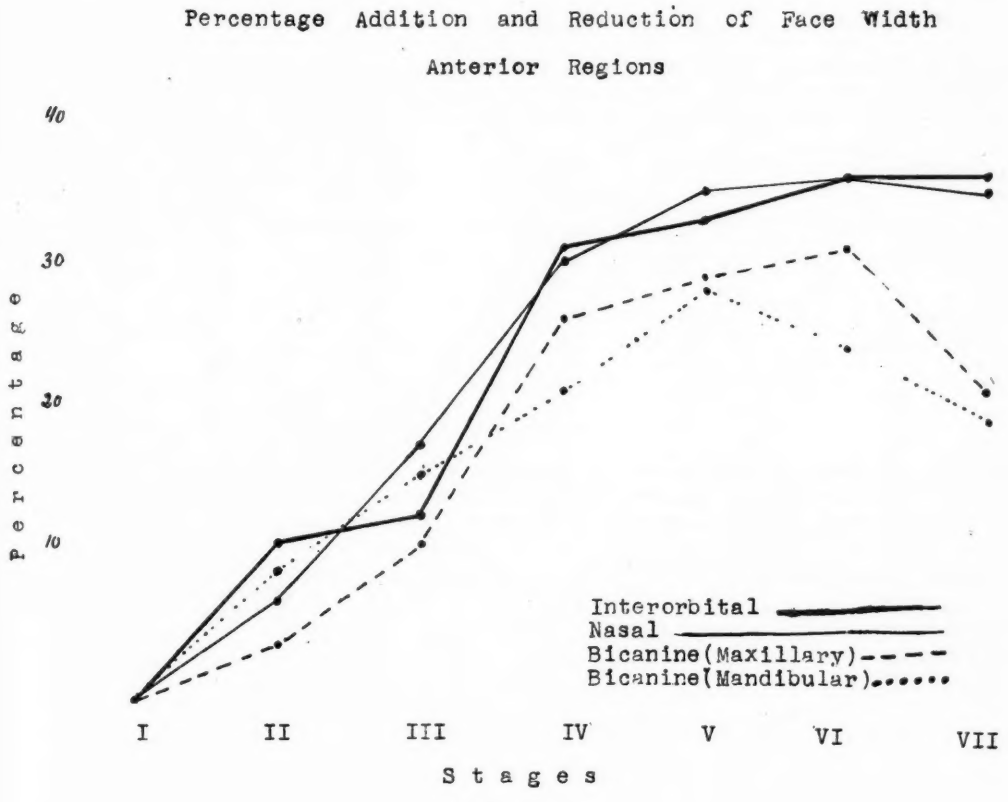

Fig. 5.

also points out some other features. For example, the excessive slowing up of the interorbital width between Stages II and III is more marked here than elsewhere, as is also the lower rate of widening in the bicanine region in the interval from Stage I to II. But the interesting feature *is that the anterior region of the face as a whole widens at a slower rate than the posterior and that the most medial areas in the anterior region increase at a higher rate than those further away from the median line.* Thus the curves representing the interorbital and nasal width assume a higher position than those of the upper and lower bicanine regions.

Fig. 7 illustrates the prevailing tendency of increasing the rate at which the face widens as the anterior lateral regions are compared with the posterior lateral ones. Thus, comparing the bicanine or minimum alveolar width

TABLE XXIV

SHOWING CHANGES IN DIMENSIONS OF THE SAME REGION (DECIDUOUS SECOND MOLAR AND PERMANENT FIRST MOLAR) AT DIFFERENT STAGES (MAXILLARY ALVEOLAR ARCH WIDTH)

REGION	STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
Deciduous Second Molars	II	10	48.80	2.04	3.80	—
	III	5	52.20	1.17	3.40	7
Permanent First Molars	III	11	57.73	2.42	5.53	—
	IV	8	60.86	2.28	3.13	5
	V	15	63.93	2.46	3.07	5
	VI	17	63.18	3.33	–0.75	–1

TABLE XXV

SHOWING CHANGES IN DIMENSIONS OF THE SAME REGION (DECIDUOUS SECOND MOLAR AND PERMANENT FIRST MOLAR) AT DIFFERENT STAGES (MANDIBULAR ALVEOLAR ARCH WIDTH)

REGION	STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
Deciduous Second Molars	II	9	45.00	2.36	—	—
	III	7	47.71	2.19	2.71	6
Permanent First Molars	III	7	55.58	1.92	7.87	—
	IV	8	55.10	3.33	–0.48	–1
	V	15	59.80	2.85	4.70	+8
	VI	17	57.77	2.94	–2.03	–3

TABLE XXVI

SHOWING CHANGES IN DIMENSIONS OF LOWER MAXIMUM ALVEOLAR WIDTH AT DECIDUOUS FIRST AND SECOND MOLARS, PERMANENT FIRST, SECOND AND THIRD MOLARS

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	10	43.80	2.76	—	—
II	9	45.00	2.36	1.20	3
III	7	55.58	1.92	10.58	24
IV	8	64.39	2.76	8.81	16
V	15	69.60	4.11	5.21	8
VI	20	68.35	3.84	– 1.25	– 2
VII	13	60.75	8.40	– 7.60	–11

Note: Stage I the measurements were made in the region of the deciduous first molar; stage II in that of the deciduous second molar; stage III, in the region of the permanent first molar; stage IV, second molar; stages V, VI, and VII, in the region of the third molar.

TABLE XXVII

SHOWING CHANGES IN DIMENSIONS OF MINIMUM WIDTH OF MANDIBULAR ALVEOLAR ARCH (BICONIAL WIDTH)

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	11	26.73	3.24	—	—
II	11	29.18	1.40	2.45	9
III	8	31.25	2.49	2.07	7
IV	7	33.00	1.41	1.75	6
V	15	35.20	2.85	2.20	7
VI	21	33.70	2.51	–1.50	–4
VII	14	32.08	3.12	–1.62	–5

with the maximum alveolar width, and the bimalar with the bizygomatic width, there is a noticeable increase in the rate of widening. The process of widening of the maximum alveolar arch should be of particular interest to the orthodontist. You will notice in this figure the character of the curve of the percentage addition and reduction of the maximum maxillary alveolar arch. In its general aspect it assumes the same form as the rest of the curves. It should, however, be understood that the width measurements of the alveolar arch are not taken at the same points in all the seven stages. In Stage I, for example, the measurement is taken between the widest points on the buccal

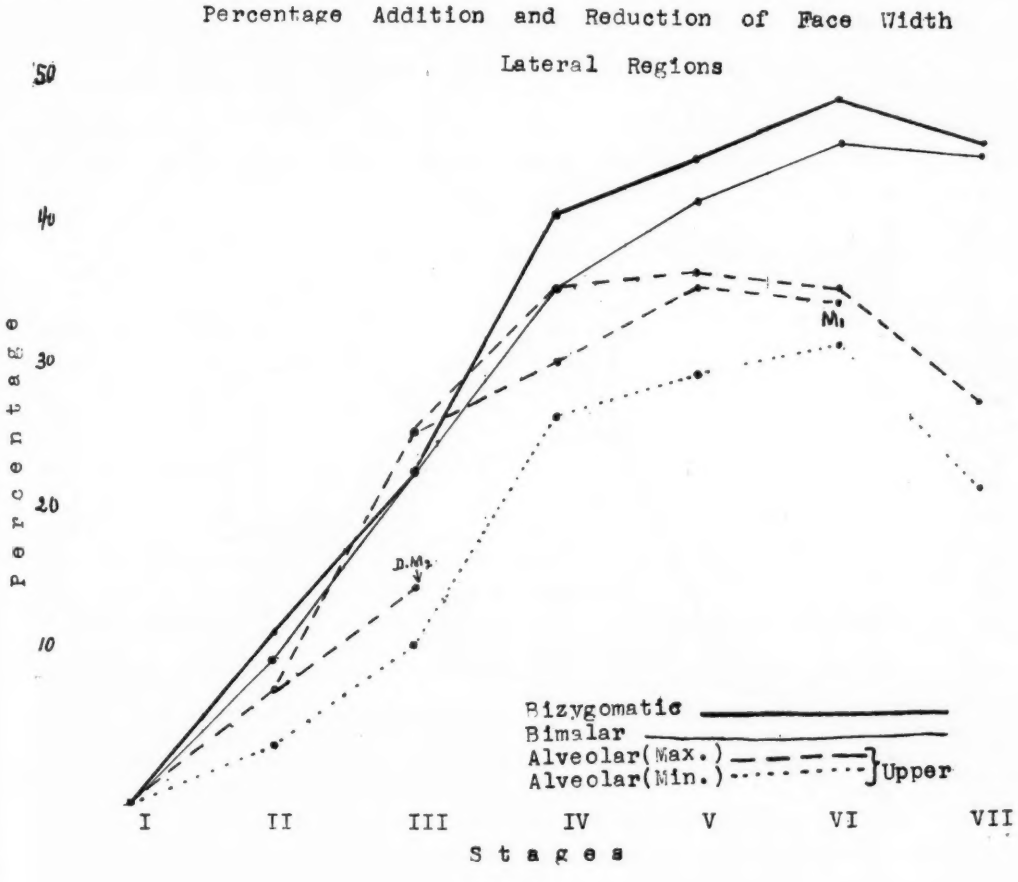

Fig. 6.

plate of the alveolus of the deciduous first molars. In Stage II the like points are used, but in the region of the deciduous second molars. In Stage III the first permanent molar is used as the landmark; in IV, the second molar; in V, VI and VII, the third molar. The increase in width may therefore be attributed to the lengthening (or deepening) of the alveolar arch. This is *quite* so, but not *entirely* so. If the measurement of the same point is repeated at different stages, there is an increase in width anyway. Thus, measurements of the alveolar width in the region of the maxillary deciduous second molar at Stages II and III show an increase of 3.4 mm. or 7 per cent of increment. Measurements of alveolar width in the region of the permanent first molar, at Stages III to IV show an increase of 3.13 mm., at Stages IV to

V an increase of 3.07 mm. (see Table XXIV and Fig. 6 short broken line DM_2, first and second molars). In the mandibular alveolar arch the same sort of evidence may be obtained. Tables XXIV and XXV and Fig. 7, solid line, clearly show the characteristic curve of percentage addition in the widening of the mandibular alveolar arch. The figure also illustrates the increase in width of the same region when measured at different stages of development (short solid line, D, first and second molars). In this illustration the fact becomes quite clear that in the process of widening of the alveolar arches, the mandibular maximum exceeds by far the percentage increment of the de-

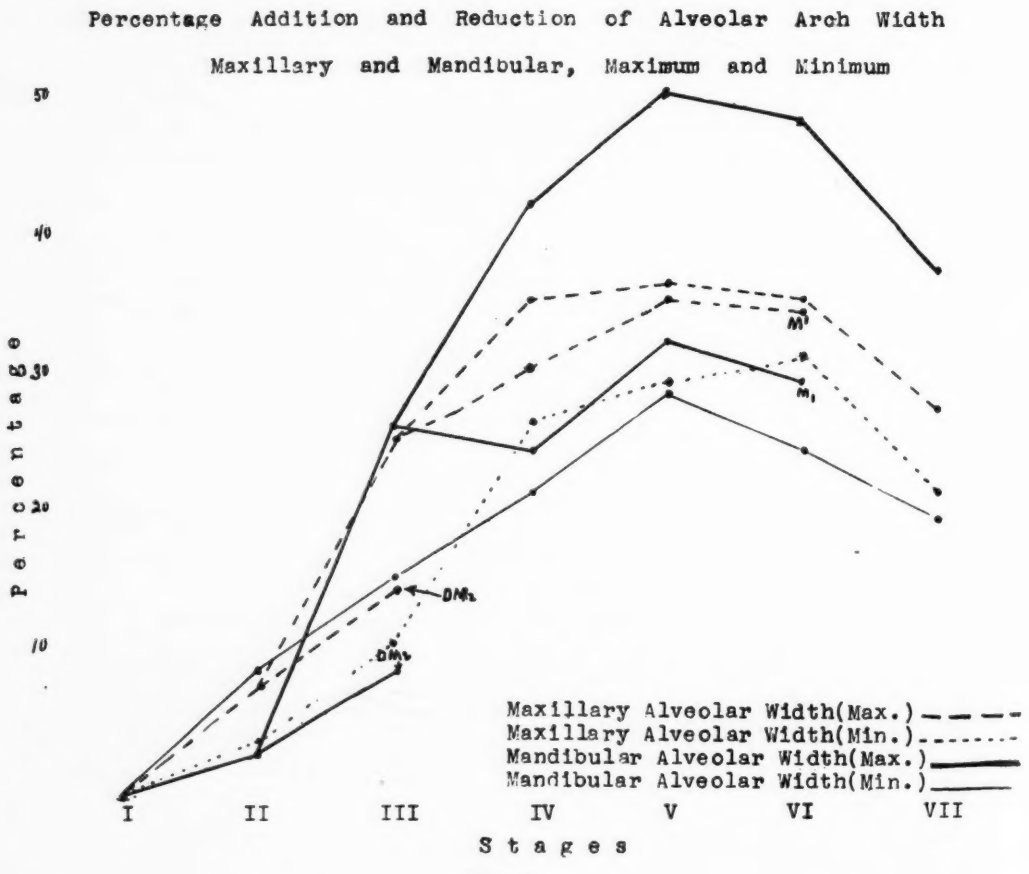

Fig. 7.

velopment of the maxillary; the maxillary maximum width again develops faster than the maxillary minimum width. The mandibular minimum width is slowest in development and grows least. In other words, the mandibular alveolar arch spreads out more posteriorly than the maxillary, which on the other hand, widens more anteriorly. Another illustration proving the point that the posterior region develops faster is presented in Fig. 8. The curves in this figure represent the rate of growth in width of the palate in two regions, the minimum width in front and the maximum width in back. Notice the difference in the position of the curves. The maximum widening takes place at almost twice the rate as the minimum, because it is further back.

The best description of the developmental changes affecting the width

of the face that I can give is the following: Suppose we take a face mask and hold it in a position as though it were on some one's face. We then divide this mask in the middle vertically. If the two halves are then moved apart, it would illustrate the effect of the widening as it occurs in the growth process at the median plane. But if in addition to the separation, the mask is also spread a bit more in the rear and this spreading further increased from below, it would convey an adequate idea of the picture of the entire event.

C.—*Measurement of the Face Depth.*

Coincident with the change in development of the face in height and in width there are also changes taking place that modify the facial depth. The changes affecting facial depth seem to be less clearly understood than those associated with its height or width. It is known that the depth of the face increases during the course of development in an anteroposterior direction.

TABLE XXVIII

SHOWING CHANGES IN DIMENSIONS OF TOTAL PALATE DEPTH (LENGTH)

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	28.16	1.72	—	—
II	10	32.30	1.19	4.14	15
III	11	37.00	1.65	4.70	15
IV	10	43.30	2.82	6.30	17
V	15	45.19	4.02	1.89	4
VI	22	47.81	2.76	2.62	6
VII	11	46.65	3.21	−1.16	− 2

TABLE XXIX

SHOWING CHANGES IN DEPTH OF PALATE FROM ANTERIOR MARGIN OF PALATINE FOSSA TO TRANSVERSE PALATINE SUTURE

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	21.57	1.18	—	—
II	10	23.30	1.79	1.73	8
III	11	28.45	1.29	5.15	22
IV	10	33.50	2.76	5.05	18
V	16	35.14	2.79	1.64	5
VI	23	36.07	2.43	0.93	3
VII	12	36.08	1.71	0.01	—

TABLE XXX

SHOWING CHANGES IN DIMENSIONS OF PALATE PROCESS OF PALATE BONE IN DEPTH (WIDTH)

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	6.57	0.91	—	—
II	10	7.20	2.91	0.63	2
III	11	8.55	1.23	1.35	19
IV	10	9.80	3.06	1.25	15
V	15	10.59	3.78	0.79	8
VI	22	11.96	2.61	1.37	13
VII	11	11.00	2.00	−0.96	− 8

The idea is therefore advanced that the face grows forward. Does it really do that? If measurements of the total palate depth (length) are taken (Table XXVIII), it is found that its dimensions increase from Stage I to Stage VI, after which there is a slight decrease. If the palate process of the maxilla and that of the palate bone are measured separately (Tables XXIX and XXX), it is found that the latter increases more slowly than the former until Stage V is reached, after which the posterior portion increases and decreases at a higher rate than the anterior. Has the palate grown forward

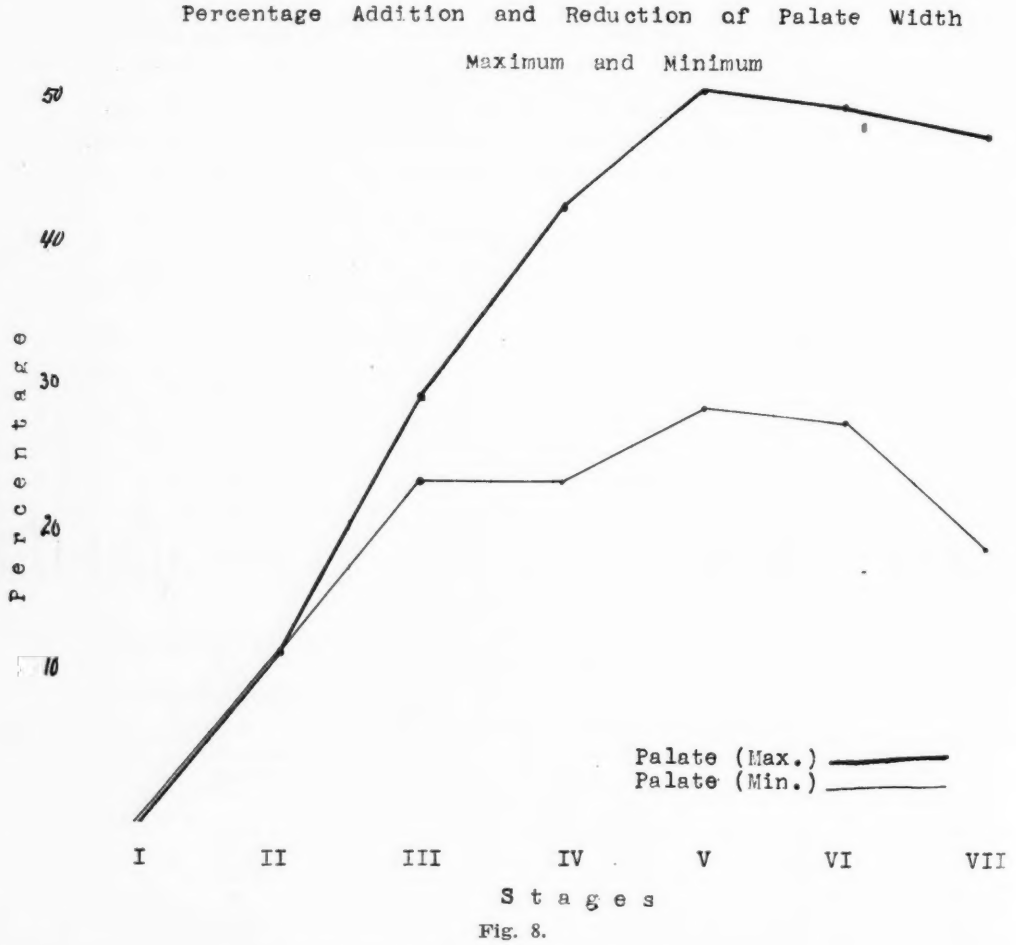

Fig. 8.

or has it grown backward? If, on the other hand, anteroposterior measurements are taken of the depth* (length) of the alveolar arch (Table XXXI), it is found that it grows at a considerably higher rate than either or both portions of the palate. But measurements of the alveolar arch, taken at the different stages, are obtained from different points. Thus, at Stage I the posterior point is in the middle of a transverse line stretched across the palate behind the deciduous first molars, while at Stage II it is behind the deciduous second molar. At Stage III the transverse line is behind the permanent first molar. At Stage IV it is behind the permanent second molar

*The term depth is used here with reference to the face. This dimension of the alveolar arch is usually called *length*. To avoid misunderstanding, both terms are mentioned.

and at all subsequent stages, behind the third molar. It becomes quite clear then that as molar after molar is added on behind the existing front segment of the alveolar arch, the arch grows deeper and deeper. When the "adding on" situation stops, there is not only a cessation of increment, but an actual decrease in depth. Measurements, on the other hand, of the same areas at different stages prove the converse of this point. When the distance anterior to the line behind the deciduous second molar is measured in Stages II and III, there is a diminution in depth. The same thing happens when like measurements are made anterior to the line behind the permanent first molar in Stages III, IV, V and VI (Table XXXII). If in spite of the de-

TABLE XXXI

SHOWING CHANGES IN DIMENSIONS OF MAXILLARY ALVEOLAR ARCH DEPTH (LENGTH)

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	8	19.25	1.20	—	—
II	10	25.10	1.87	5.85	30
III	10	35.50	1.50	10.40	41
IV	10	44.50	3.60	9.00	25
V	16	48.69	2.91	4.19	9
VI	22	48.08	4.47	− 0.61	− 1
VII	11	45.54	3.09	− 2.54	− 5

Note: Repeated measurements were taken for stage I at DM1; for stage II at DM2; for stage III at permanent M1; stage IV at M2; stage V, VI, and VII at M3.

TABLE XXXII

SHOWING CHANGES IN DIMENSIONS OF ALVEOLAR ARCH DEPTH (LENGTH), TAKEN IN THE SAME REGION AT DIFFERENT STAGES

REGION	STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
	I	—	—	—	—	—
Deciduous Second Molars	II	10	25.10	1.87	—	—
	III	3	24.60	—	−0.50	−2
	III	10	35.50	1.50	—	—
Permanent First Molars	IV	10	34.60	2.46	−0.90	−3
	V	16	34.44	1.58	−0.16	−0.5
	VI	17	34.00	2.52	−0.44	−1

Note: Repeated measurements were taken for stages II and III in the region of the deciduous second molar; for III, IV, V and VI at permanent first molar.

TABLE XXXIII

SHOWING CHANGES IN DIMENSIONS OF TOTAL MANDIBULAR DEPTH, FROM LOWER PROSTHION TO POSTERIOR MARGIN OF RAMUS IN THE PLANE OF OCCLUSAL SURFACES OF THE TEETH

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	10	48.70	2.37	—	—
II	9	55.22	2.70	6.52	13
III	8	67.00	2.12	11.78	21
IV	7	76.58	4.05	9.58	14
V	14	82.50	4.35	5.92	8
VI	21	81.90	7.15	− 0.60	− 1
VII	14	79.42	4.53	− 2.48	− 3

crease in depth of the anterior segment of the alveolar arch there is still an increase in the total depth (length), does it not prove that growth takes place from before backward?

Fig. 9 illustrates this point quite clearly. The solid line represents the percentage increments in depth of the total palate. The broken line, the changes of the anterior portion and the dotted line those of the posterior portion of the palate. The alveolar depth is indicated by the dash and dot line. The alveolar depth thus represents the distance anteriorly from the distal alveolar septum of the molars present at each stage (i.e., at Stage I, deciduous first molar; at II, deciduous second molar; at III, permanent first molar; at IV, permanent second molar; at V, VI and VII permanent third molar). The short dot and dash lines represent the repeated measurements from the distal alveolar septum of the deciduous second molar, and from

TABLE XXXIV

SHOWING CHANGE IN PRERAMUS DEPTH

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	10	29.30	2.52	—	—
II	11	31.91	1.31	2.61	9
III	8	40.14	3.12	8.23	26
IV	7	44.72	2.05	4.58	11
V	14	49.42	3.66	4.70	11
VI	21	48.01	3.96	–1.41	– 3
VII	14	44.71	1.12	–3.30	– 7

TABLE XXXV

SHOWING CHANGE IN RAMUS DEPTH (WIDTH)

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	10	20.10	2.21	—	—
II	11	23.09	1.91	2.99	15
III	8	27.00	1.73	3.91	17
IV	7	31.43	2.44	4.43	16
V	14	33.32	2.94	1.89	6
VI	21	34.42	4.17	1.10	3
VII	14	35.21	3.30	0.79	2

TABLE XXXVI

SHOWING CHANGE IN DEPTH (LENGTH) OF MANDIBULAR ALVEOLAR ARCH AT THE VARIOUS STAGES OF DEVELOPMENT

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	10	15.50	1.20	—	—
II	9	24.89	0.74	9.39	61
III	7	35.71	0.88	10.82	30
IV	7	46.00	2.28	10.29	28
V	15	50.99	3.42	4.99	11
VI	16	50.18	5.75	– 0.81	– 2
VII	12	42.74	2.58	– 7.44	–17

Note: The measurements were taken as for Tables XXXI.

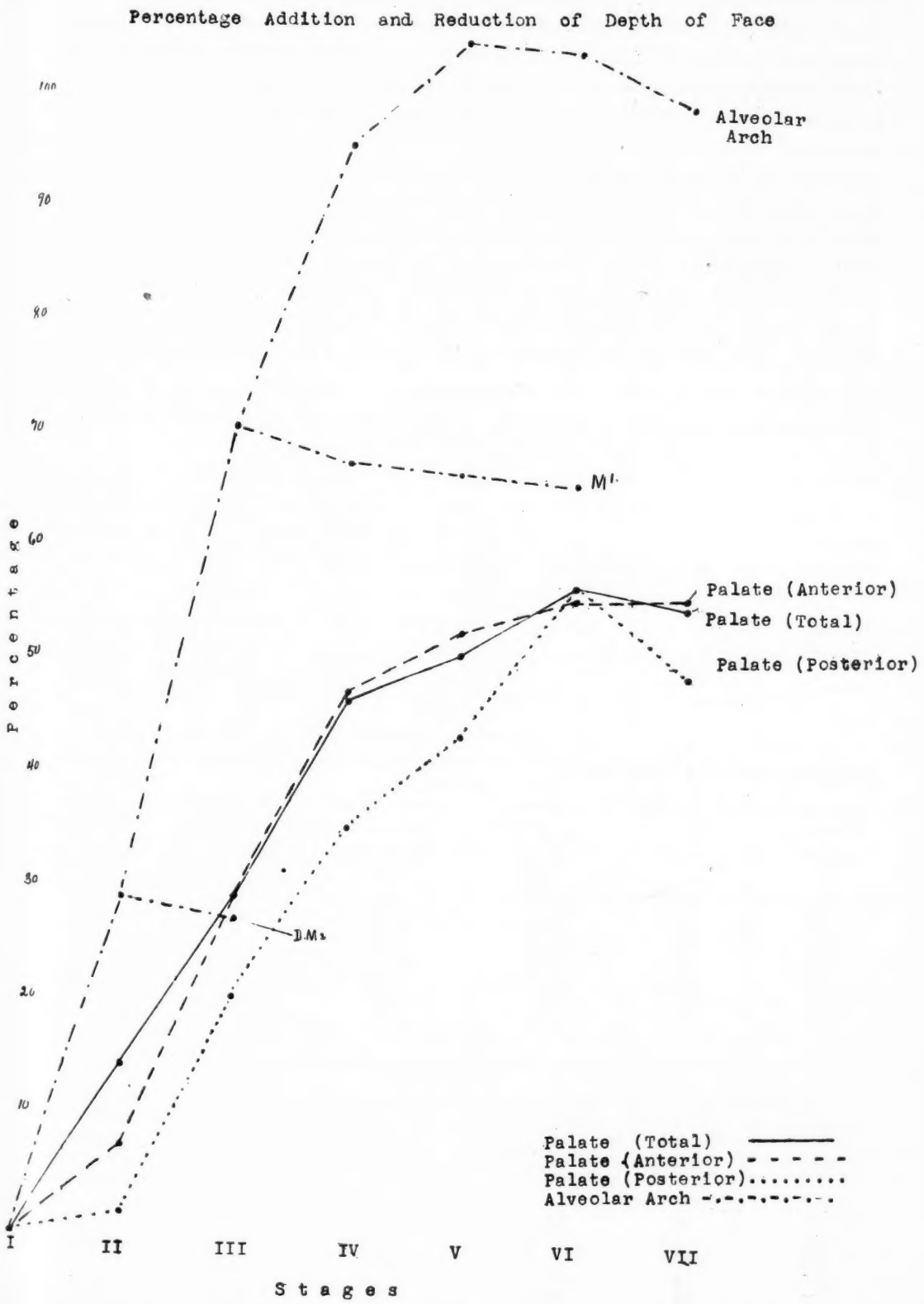
Percentage Addition and Reduction of Depth of Face
100
90
80
70
60
50
40
30
20
10
Percentage
Alveolar Arch
M¹
D.M₁
Palate (Anterior)
Palate (Total)
Palate (Posterior)
Palate (Total) ——————
Palate (Anterior) - - - - -
Palate (Posterior).....
Alveolar Arch -.-.-.-.-.-.
I
II
III
IV
V
VI
VII
Stages

Fig. 9.

the distal septum of the permanent first molar at the successive stages. This illustration depicts very adequately the manner in which the palate deepens (lengthens), when it does most of it and when least. It also shows that both the maxillary and palatine portions of the palate follow approximately the same course in development until Stage VI, when the posterior portion of the palate experiences a sudden increase in its rate of growth, which is then followed by a rapid senile decline. The alveolar curve, on the other hand, shows that it is at first very slow in getting started (Stages I and II), thereafter it is very much accelerated until Stage V, when it begins its senile decline. The decline of the alveolar arch, as has been explained, is the usual procedure when repeated measurements are taken of the same areas at different stages. In this case the measurements were taken from the third molar forward. The shorter line between Stages II and III represents the repeated

TABLE XXXVII

SHOWING CHANGE IN DEPTH OF MANDIBULAR ALVEOLAR ARCH OF THE SAME REGION MEASURED AT DIFFERENT STAGES*

REGION	STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
Deciduous Second Molars	II	9	24.89	0.74	—	—
	III	3	23.33	—	−1.56	− 6
Permanent First Molars	III	7	35.71	0.88	—	—
	IV	6	32.00	1.92	−3.71	−10
	V	15	30.39	2.43	−1.61	− 5
	VI	17	29.65	1.97	−0.74	− 2

*Measurements the same as for Table XXXII.

TABLE XXXVIII

SHOWING CHANGE IN DIMENSIONS IN BASAL DEPTH (LENGTH) OF MANDIBLE FROM MENTON TO GONION

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	10	40.80	1.94	—	—
II	11	48.46	2.82	7.66	19
III	7	62.32	3.93	13.86	29
IV	7	72.15	4.50	9.83	16
V	15	79.39	5.01	7.24	10
VI	20	79.50	5.20	0.11	0.1
VII	14	77.79	4.59	− 1.71	− 2

TABLE XXXIX

SHOWING CHANGES IN DIMENSIONS FROM EXTERNAL AUDITORY MEATI TO MASION

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	9	65.01	4.47	—	—
II	9	70.34	2.34	5.33	8
III	14	76.63	4.11	6.29	9
IV	9	85.34	3.09	8.71	11
V	21	88.55	5.35	3.21	4
VI	22	91.60	4.10	3.05	3
VII	12	89.25	4.92	−2.35	− 3

measurements from the deciduous second molar forward, while that from Stage III to VI, the repeated measurement from the permanent first molar. They too show decline. In other words, any portion of the alveolar arch, as soon as it is completed, begins to decline. All increases in the dimension of depth are made by posterior additions of new portions to the existing anterior segment.

Similar evidence may also be obtained from the measurements obtained of the mandible (Table XXXIII). These measurements of the mandible were, however, taken in a different way. The mandibular prosthion and a point in the middle of a line stretched across the posterior borders of the ramus were the points measured. The plane in which these measurements were taken was that of the occlusal surface of the teeth. This I call the alveolo-ramus depth. The second measurement was then made in front of the anterior border of the rami to the lower prosthion. This measurement I call preramus depth and the third measurement, the ramus depth (or width). All three measurements were made in the same plane. (See Tables XXXIV and XXXV). By Tables XXXIII, XXXIV and XXXV the result is easily seen. Of course, the total depth (Table XXXIII) is seen increasing from stage to stage until V is reached, when the decline sets in. The preramus portion, however, declines more sharply, while the ramus increases its dimensions until senility. This fact certainly proves that both the ramus and the preramus portions of the mandible grow equally in depth. But using the same kind of evidence by means of tracing the growth changes of the mandibular alveolar arch (Tables XXXVI

TABLE XL

SHOWING CHANGES IN DIMENSIONS FROM EXTERNAL AUDITORY MEATI TO MENTON

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	66.40	4.40	—	—
II	8	75.00	5.00	8.60	13
III	7	88.99	3.27	13.99	19
IV	6	107.50	3.36	18.51	21
V	13	113.85	7.40	6.35	6
VI	20	115.75	6.20	1.90	2
VII	12	111.51	3.66	– 4.24	– 4

TABLE XLI

SHOWING CHANGES IN DIMENSIONS FROM EXTERNAL AUDITORY MEATI TO MAXILLARY PROSTHION

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	62.29	0.80	—	—
II	9	68.34	3.39	6.05	10
III	11	78.54	3.33	10.20	15
IV	9	89.67	3.60	11.13	14
V	16	95.57	4.35	5.90	7
VI	22	99.20	4.90	3.63	4
VII	12	93.75	4.26	– 5.45	– 6

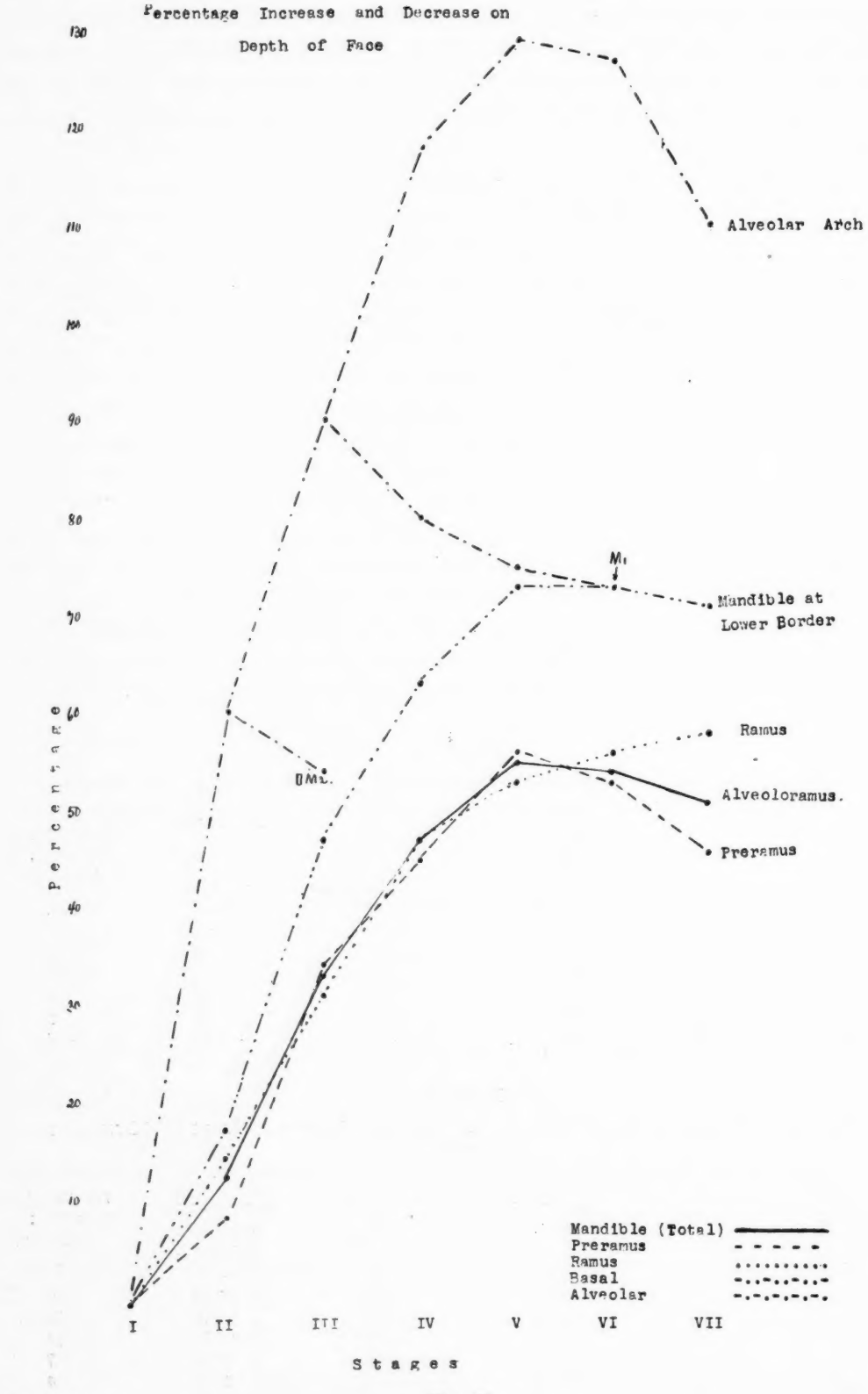
Percentage Increase and Decrease on
Depth of Face
Alveolar Arch
M1
Mandible at
Lower Border
M2
Ramus
Alveoloramus.
Preramus
Mandible (Total)
Preramus
Ramus
Basal
Alveolar
Percentage
I
II
III
IV
V
VI
VII
Stages

Fig. 10.

TABLE XLII

SHOWING CHANGES IN DIMENSIONS FROM EXTERNAL AUDITORY MEATI TO MANDIBULAR PROSTHION

STAGE	NUMBER	MEAN IN MM.	STANDARD DEVIATION IN MM.	ABSOLUTE INCREASE OR DECREASE IN MM.	PERCENTAGE INCREASE OR DECREASE
I	7	62.86	1.28	—	—
II	8	67.89	3.66	5.03	8
III	7	82.91	2.49	15.02	22
IV	6	96.33	1.49	13.42	16
V	13	100.85	4.50	4.52	5
VI	20	102.20	2.98	1.35	1
VII	11	95.90	7.65	- 6.30	- 6

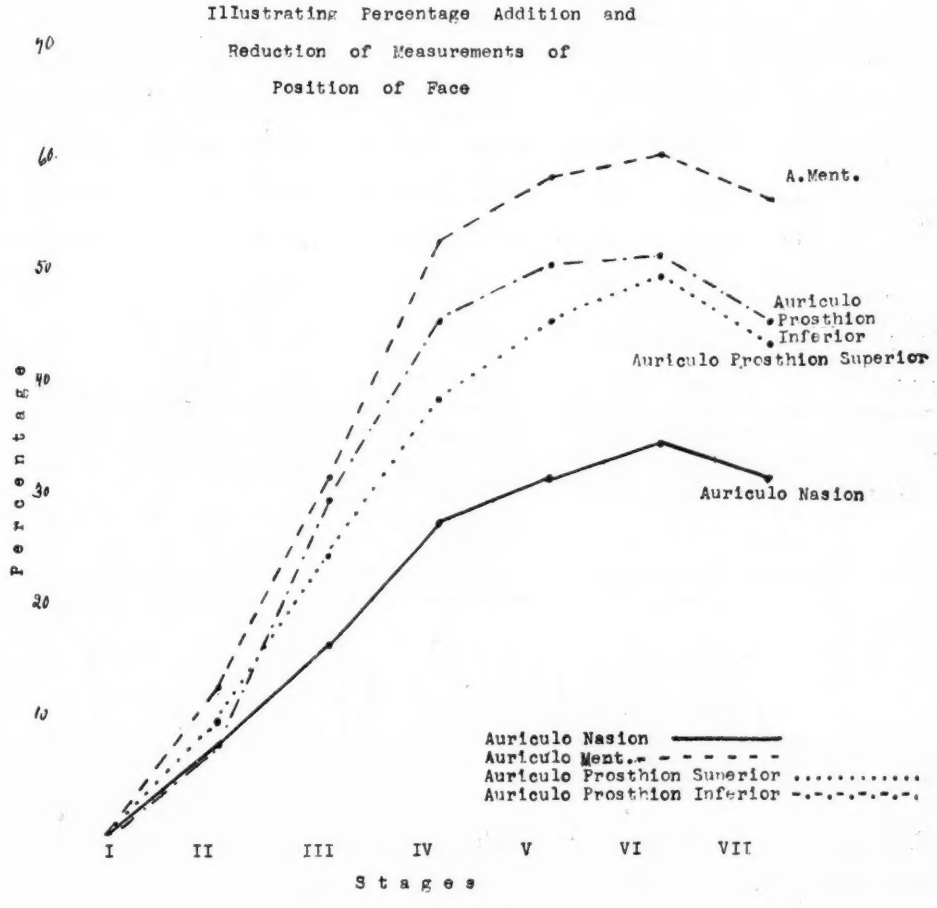

Fig. 11.

and XXXVII) as was done in the study of the palate, we cannot avoid reaching the same conclusion. Namely, the alveolar arch in the mandible increases its depth by increments from behind to the existing segment in front. But also the ramus increases its depth (width) by a similar process of addition. As the preramus portion keeps on increasing its depth, however, the ramus keeps on getting wider, but at the same time the posterior border of the ramus keeps on getting further away from the prosthion.

Fig. 10 illustrates the percentage increase and decrease in the measure-

ments at the different stages, in addition to which there is added the curves of the measurements of the mandible at the lower border from menton to gonion and those of the mandibular alveolar arch (Table XXXVIII). Nothing can be said in explanation of this figure without repeating what was said before, in connection with Fig. 9. The contents are plain and readable.

The conclusion may now safely be reached that changes in depth of face during the course of development are due to posterior increments. In other words, it can safely be stated that the face increases its depth not by growing forward, but by growing backward. But it must, at the same time, be remem-

TABLE XLIII

SHOWING COMPARISONS OF MEASUREMENTS OF DIFFERENT GROUPS INDICATING POSITION OF FACIAL MASK RATHER THAN GROWTH OF FACE

GROUP	AURICULO-NASION			AURICULO-MENTON			AURICULO-PROS-THION SUPERIOR			AURICULO-PROS-THION INFERIOR		
	N	M	S.D.	N	M	S.D.	N	M	S.D.	N	M	S.D.
Ancient Am. Ind.	21	88.55	5.35	13	113.85	7.40	16	95.57	4.35	13	100.85	4.50
Flat-head Am. Ind.	13	86.55	6.00	13	115.75	7.05	13	100.65	4.75	13	105.62	4.95
Occip. Flat Am. Ind.	10	87.50	5.60	10	115.50	7.55	10	95.00	5.90	10	100.50	7.25
Whites Male W. R. U.	49	91.30	3.49	49	117.85	5.28	49	95.00	4.60	—	—	—
Whites Salzburg	11	87.25	5.80	10	117.00	5.55	11	94.65	3.81	8	104.35	5.25
Negroes W. Africa	32	88.25	5.16	32	114.55	7.10	32	100.80	6.25	32	106.25	5.10
Australians	27	88.88	3.54	23	114.15	4.60	26	102.14	3.24	23	107.88	4.15
Tasmanians	7	90.13	3.84	7	119.30	5.70	7	106.42	4.92	7	108.58	5.19
Hindoos	42	88.22	4.68	42	108.45	6.85	42	94.65	5.75	30	98.59	5.52

N — number, M — Mean, S.D. — standard deviation.

TABLE XLIV

SHOWING COMPARISONS IN BASAL DEPTH (LENGTH) OF MANDIBLE

	ANCIENT AMERICAN INDIANS	FLATHEAD AMERICAN INDIANS	OCCIPITAL FLATTENING AM. IND.	WHITES W. R. U.	WHITES SALZBURG	NEGROES WEST AFRICA	AUSTRA-LIANS	TASMAN-IANS	HINDOOS
Mean	79.73	78.92	81.80	77.84	73.30	79.10	79.74	85.00	71.20
Standard deviation	5.01	4.74	6.33	4.83	5.43	8.10	3.75	5.79	3.75

bered that, as in the increase in height, the upper and lower face are being wedged apart, so to speak, by the development of the dentition; as in the widening of the face the posterior ends of the facial mask undergo an additional spreading to the lateral growth in the middle area, so also during the increase in its depth the face-mask as a whole migrates—if this term be permitted—forward. This brings us to a consideration of another matter.

D—*Measurements of Position of the Face.*

In the foregoing remarks measurements were discussed that have reference to dimensions of structure. I shall now discuss several other measurements the significance of which have hitherto been misinterpreted. I have discussed extensively the three planes in which the face grows during the course of development and how they were measured. If a set of measure-

ments were taken from the external auditory meati on both sides by means of a bow to the nasion and another to the menton, would those measurements indicate the growth of the face? The many and varied measurements of this sort secured on a great variety of skulls warrant the statement that these measurements really measure no growth, but rather position. In other words, if we wish to determine how far the nasion and menton travel away from the cranium during the course of development of the face, these measurements will determine it. (See Tables XXXIX and XL.) There are also two other measurements, the auriculo-prosthion-superior and inferior which determine the position of the dentition in relation to the face. (See Tables XLI and XLII.)

TABLE XLV

SHOWING CHANGE IN FACIAL ANGLE IN THE COURSE OF DEVELOPMENT

STAGE	NUMBER	MEAN IN DEGREES	STANDARD DEVIATION IN DEGREES	ABSOLUTE DIFFERENCE IN DEGREES
I	6	90.00	1.15	—
II	9	91.67	2.31	1.67
III	11	87.92	3.45	–3.75
IV	9	85.67	4.98	–2.25
V	16	84.86	2.34	–0.81
VI	22	86.23	2.71	+1.37
VII	12	86.50	1.66	+0.27

TABLE XLVI

SHOWING CHANGE IN ALVEOLAR ANGLE IN THE COURSE OF DEVELOPMENT

STAGE	NUMBER	MEAN IN DEGREES	STANDARD DEVIATION IN DEGREES	ABSOLUTE DIFFERENCE IN DEGREES
I	7	80.00	1.20	—
II	9	85.00	1.83	+ 5.00
III	11	79.10	6.25	– 5.90
IV	9	62.20	5.35	–16.90
V	16	62.20	5.00	—
VI	22	64.75	5.90	+ 2.55
VII	12	67.10	6.90	+ 2.45

Fig. 11 depicts the percentage increase and decrease of the measurements in a very convincing way. The solid line represents the auriculonasion distance; the dotted line, the auriculo-prosthion-superior distance; the dash and dot line, the auriculo-prosthion-inferior; and the broken line the auriculo-menton distance. Notice that all these curves indicate increase in dimension from I to VI. After this there is a general decline. But notice also that as we descend from the nasion to the menton, the percentage additions occur at a higher rate. This means that the entire face departs from the external auditory meati. But in doing so the nasion moves slower than the upper prosthion, the upper prosthion slower than the lower prosthion and the latter slower than the menton. In other words, as the face grows in depth, the facial mask as a whole moves forward. But in this movement, the lowermost point (menton) moves further than the upper, because it moves faster during the same period. This forward movement of the face mask must, however, not be confused with the facial growth in depth. Compare, for

Percentage Addition and Reduction of Composite Maxima in Height, Width, Depth, Position of Face and Mandibular Angle

12

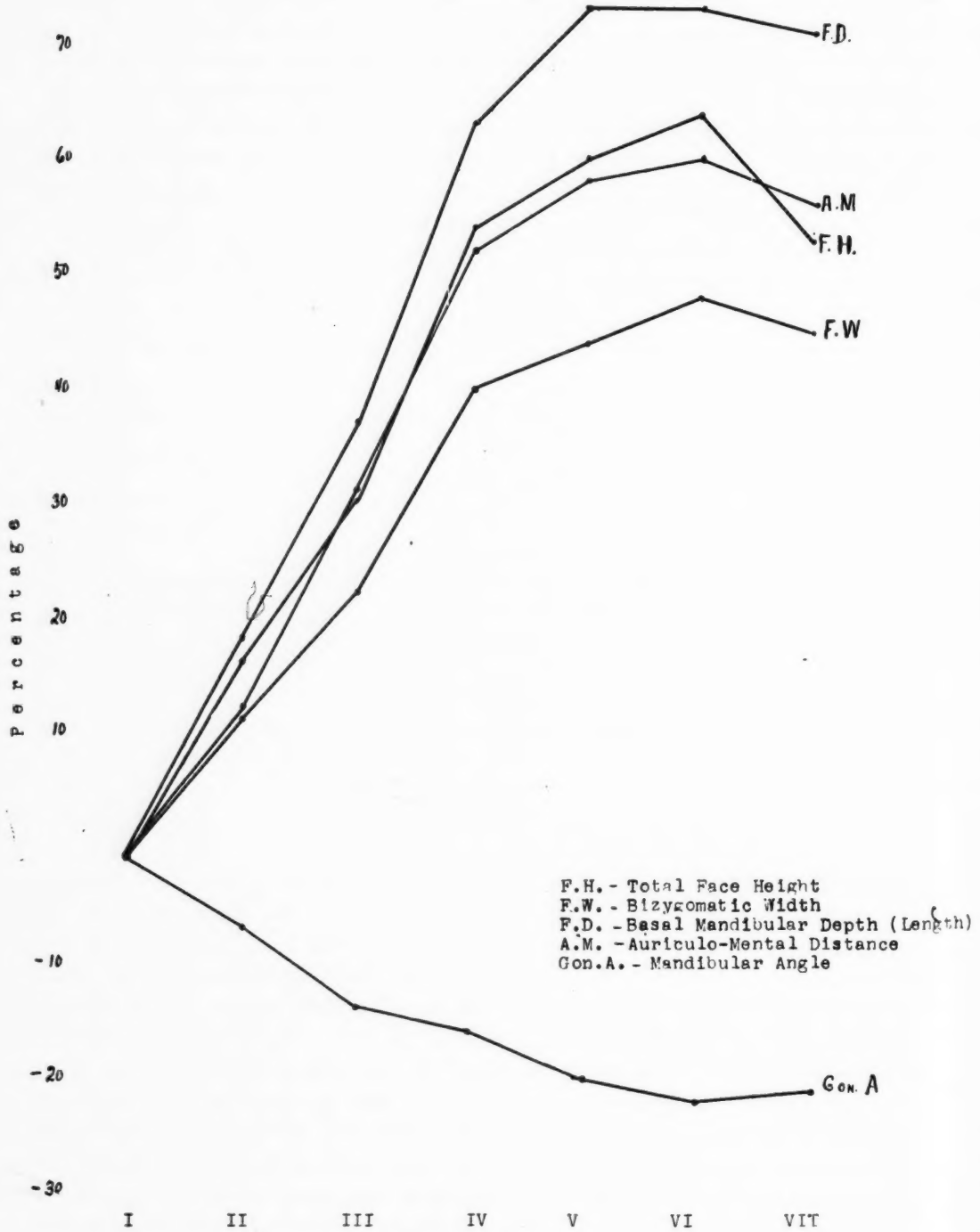

Fig. 12.

example, the curves of Fig. 9 representing the percentage additions of the upper alveolar arch (dot and dash line) with that representing the same phenomenon of the auriculo-prosthion-superior (dotted line). Note the difference in the percentage addition. The former reaches a rate of 107 per cent, while the latter only 50 per cent. Or compare the curve in Fig. 10, representing the basal mandibular (dash and double dot line) with that in Fig. 11, representing the auriculo-menton (broken) line. The former increases its dimension at a much higher rate, reaching 74 per cent, while the rate of the latter reaches only 61 per cent. These two instances prove beyond the shadow of a doubt that the percentage additions in structural development occur at a higher rate than those in their readjustment. In other words, the face grows faster backward than the facial mask moves forward.

TABLE XLVII

SHOWING CHANGE IN MANDIBULAR ANGLE IN THE COURSE OF DEVELOPMENT

STAGE	NUMBER	MEAN IN DEGREES	STANDARD DEVIATION IN DEGREES	ABSOLUTE DIFFERENCE IN DEGREES
I	11	138.19	3.15	—
II	11	132.46	5.55	–5.73
III	8	124.25	3.90	–7.21
IV	7	122.16	2.40	–2.09
V	15	117.39	5.58	–4.77
VI	21	115.65	4.35	–1.74
VII	14	116.80	6.95	+1.15

TABLE XLVIII

SHOWING CHANGE IN MENTAL ANGLE IN THE COURSE OF DEVELOPMENT

STAGE	NUMBER	MEAN IN DEGREES	STANDARD DEVIATION IN DEGREES	ABSOLUTE DIFFERENCE IN DEGREES
I	11	75.90	5.35	—
II	11	75.29	3.48	- .61
III	7	76.29	4.20	1.00
IV	7	69.29	4.77	–7.00
V	15	68.65	5.90	–0.64
VI	20	67.50	7.65	–1.15
VII	13	63.85	9.45	–6.75

This point may be proved from another angle by a different sort of evidence. Let us compare similar measurements of a few racial groups and see what they have to offer (Table XLIII). This table is more for comparisons to be made of the relative changes between the different points in the different groups. You will notice the increase in dimension from nasion, to upper prosthion, to lower prosthion and to menton. This fact holds true in all groups, as it does in our study series.

To prove the point, that growth takes place at a higher rate than does readjustment in position, we will choose the two extreme groups, the Tasmanians and the Hindoos (Tables XLIII and XLIV). The former have an extremely deep (long) mandible (average 85 mm.), while the latter have a very short one (average 71.2 mm.). There is a difference of 14 mm. between the averages of the two. The auriculo-menton dimension in the Tasmanians has an average distance of 119 mm.; that of the Hindus is only 108 mm., a difference of 11

mm. Now 14 mm. of the shorter dimension is a very considerably higher per cent than 11 is of the greater measurement. Compare, on the other hand, the Whites (Salzburg, Austria) and the Australian aboriginal group. The former show an auriculo-menton dimension of 117 mm.; the latter 119 mm., a difference of 2 mm. The difference in the two groups in the basal depth of the mandible, as is seen in Table XLIV, is 6.5 mm. This again shows that there is a greater difference in the dimension of the structure than in that of its position. The Tables XLIII and XLIV are replete with interesting comparisons bearing out the contention that the measurements referred to are measurements of the position of facial mask and not of magnitude of its structure.

E—*Measurements of Angles.*

The angles of the face concerned in the modification during development are the facial, the alveolar, the gonial and the mental (see measurements). The changes taking place in the angles in general show a tendency toward a closing up, so to speak (see Tables XLV, XLVI, XLVII, and XLVIII). All angles are more obtuse at first, becoming more acute as development goes on. There is, however, a difference between the gonial and the other angles. The gonial begins with an average of 138° and closes up to an average of 116°, while the others begin with 90° or below and keep on getting smaller and smaller.

The facial angle (Table XLV) and the alveolar angle (Table XLVI) show an increase in degrees in infancy. This is due, undoubtedly, to the growth of the cranium. There is another increase in old age in both, and in senility, in the alveolar angle only; probably due to the atrophy of the alveoli subsequent to the loss of teeth. The mental angle (Table XLVII) keeps on getting smaller all the way; while the gonial (Table XLVIII) has an increase of just 1° in senility.

The traditional idea that the "angle of the jaw" begins and ends with a straight line must herewith be refuted. Whether in the fetus or in the senile, there is always a marked angle varying in degree, as do all other living structures. I wish the statement to go on record that I have yet to see the gonial angle, either of the fetus or of the senile skull, that cannot be duplicated in fully developed adult mandibles of certain types.

SUMMARY

The facial changes depicted in this paper must not be understood to represent a complete statement of its development. They represent just a few of the many ways in which the face goes through the life cycle from the infant to the senile stage of development. These few ways consist of:

1. Growth in height.

   This growth is attained by:

   a. Moderate increase in dimension of the upper and lower face.

   b. Greater increase in the subnasal area and lower molar region, really the alveolar process.

   c. Development of the dentition, pushing, as it were, the upper and lower face apart.

2. Growth in width.

This growth is attained by:

a. Moderate increase in width in the median plane anteriorly.

b. Greatest increase in width in the lateral halves posteriorly, especially at the gonion.

c. Intermediate amounts of growth posteriorly ascending from the gonion and laterally between gonion and canine.

3. Growth in depth.

This growth is attained by:

a. Increase in dimensions of facial structures in anteroposterior direction.

b. The increment taking place at the posterior end of the structures concerned, palate and alveolar process of the maxilla above and alveolar process ramus and body of mandible below.

c. The lower in position the structures are, the more rapidly they grow.

4. Adjustment of Facial Position.

This is determined by measurements taken from a point in the cranium (external auditory meati) to certain anterior points of the face in the median line (Nasion, Prosthion and Menton). These dimensions hitherto thought to measure growth are shown to measure position.

5. Modification of the Different Angles.

The angles are shown to change in an opposite direction to the other measurements; i.e., the other dimensions grow larger during development while the angles grow smaller in degrees. The traditional idea of the modification of the mandibular angle cannot be upheld.

There are thus five ways in which the face changes during development. These are readily recognized and well understood. To be sure, there must be many more ways that come into this very complex process, but those are not as yet known, and consequently not understood.

If we could only combine at least the changes in these five known directions, and conceive them as taking place simultaneously, then we would approximate the picture of the complete event in the development of the face. But we would then appreciate to a certain extent only *how* this event happens. It would, however, be necessary to know also *when* it happens in order to have a clear idea of the process.

Let me attempt to make such a composite picture for you. If just the maximum change in each of the directions be plotted on the same time scale, in this case the stages of development, an approach to the combined activity may be reached. Thus in Fig. 12, the total height, bizygomatic width, basal mandibular depth (length), auriculo-menton distance and gonial angle are plotted on the same graph. Notice that the face width increases the slowest, the face height more rapidly and the face depth the fastest. The curve for the angle takes a negative course. The auriculo-menton curve proceeds at a slower rate than that of the facial depth. The interesting feature in this

composite picture is that all the curves are practically of the same form. There are nevertheless two important exceptions. One is, that, as in all the other graphs, there is a steep rise of the lines F.H. and F.W. connecting I and II and another even a little more steep than this between III and IV. Between II and III there is a less steep rise. This simply means there is an acceleration in the rate of growth in height and width of the face at two stages of development. The first and lesser is between infancy and childhood; the second and more accentuated from chidhood to pubescence. The F.D. and A.M. curves on the contrary show the slower ascent from I to II and the steeper from II to III. After this, the curves keep on rising, but more gradually until old age, when they all descend, the F.H. line more than any of the others. In other words, the face becomes shorter on account of the loss of teeth than it narrows or flattens in senility. The curve of the mandibular angle, on the other hand, descends gradually until old age, after which there is a very slight rise. That is, the angle is obtuse at the beginning, becoming gradually acute until senility, when it becomes again obtuse by one degree.

CONCLUSIONS

Thus I have endeavored to interpret a few of the phenomena in the complex process of development. The reason for it rests, as you all know, on practical needs. I, as an orthodontist, know quite well what can be accomplished by means of orthodontic appliances. But I did not know how the face develops without orthodontic aid. I also thought I knew the best time when to begin orthodontic treatment, but I did not know when the most exuberant growth occurs without orthodontic treatment. The facts revealed by this study should make one wary of several things:

1. The very complex nature of development as it concerns the human face.
2. The efficiency with which this process has been attended to for hundreds of thousands of years without the aid of orthodontic appliances.
3. The great care necessary to determine just *when* these natural phenomena are in need of assistance.
4. The risk of attempting to do something with orthodontic appliances that might be accomplished in the course of time by natural development.

Before concluding my remarks, I desire to acknowledge with many thanks the privilege extended me by the American Museum of Natural History to do the research work entailed in this study. Not only was one of the greatest skull collections in the world placed at my disposal, but also various courtesies in the form of help and advice were freely given me. I am deeply appreciative of all these kindnesses for which I am extremely grateful. I also wish to acknowledge with thanks the help my wife was able to give me in doing many calculations, and in the preparation of the manuscript.

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DISCUSSION

Dr. George Northcroft, London.—Under the circumstances, it seems rather undesirable that I should attempt any formal discussion of Dr. Hellman's paper. I should like to put on record my very hearty congratulations for the enormous amount of work which he must have had to do in order to present these facts before us.

I do not altogether agree with the statistical method of investigation. It is open to a very large number of fallacies. You will easily recognize, for instance, that in any one of the age groups of these Indian skulls to which he has referred, his whole calculations would have been very readily upset had one of those skulls suffered from such a pathologic condition as acromegaly.

You want an enormous number of skulls or data to get at your results if you are going to average them, and some of his age groups I feel were very much too small to produce reliable results. They are misleading in some cases I have no doubt.

One of the statements which he has made which I am practically convinced is a fallacy in my own mind is that the face goes on growing until old age. The bones of our face and head are governed by the same methods of growth which govern our long bones or any other of our skeletal structure and, therefore, why should you not say that our legs go on growing, our arms go on growing, until old age just as much as you say our faces go on growing until old age?

Dr. Hellman has undoubtedly proved this point from his statistics, but I say his statistics must be wrong. I won't detain you any longer, but I thank him very much for the very sincere work he has done and I shall look forward to reading the paper, when it is published, with a great deal of interest. Thank you.

President Fisher: Dr. Northcroft, you will have the opportunity of presenting a written discussion of this for the proceedings after you have had a chance to read and study the paper. In fact, all of the gentlemen who are to open discussions and who have not received the papers before this will be given that opportunity.

Is there any further discussion of Dr. Hellman's paper?

Dr. Herder, New York.—I want to ask Dr. Hellman whether there were any of those skulls examined with the condition of malocclusion there.

Dr. Hellman, (closing).—There is no human example of skull that does not present some malocclusion. The percentage of normal occlusion in that collection was 70.

*The papers of the last four authors were published in one volume called: "The Growth of the Jaws, Normal and Abnormal. In Health and Disease." The Dental Board of the United Kingdom. 44 Hallam St., W. 1, London.

In reply to Dr. Northcroft's criticism, I desire to say that it is rather disappointing. Confining myself to the evidence brought out in this study, I am obliged to maintain that the face does keep on growing until old age. But this is not so extraordinary. Professor T. Wingate Todd, of the Western Reserve University, in a study of the intracranial and extracranial sutures of over a thousand skulls of Whites and Negroes, shows that there is differentiation of bone in the regions of the sutures up to senility. The sutures keep on uniting until very late in life. As to the number necessary to warrant conclusion reached by statistical methods, it may be comforting for Dr. Northcroft to know that in an examination of 9190 living individuals, by the late Dr. Louis R. Sullivan, of the American Museum of Natural History, it is shown that the face increases in height and in width in those over 21 years of age. Further studies on larger skull collections in progress now, also tend to substantiate my findings. That Dr. Northcroft does "not altogether agree with the statistical method of investigation," is to be regretted. Some of his illustrious countrymen, such as Sir Francis Galton and Karl Pearson, do. They have, during the last fifty years, brought to the attention of the scientific world more facts related to biologic phenomena by the use of statistical methods, than was possible to bring out by other methods in as many decades before them. Because we do not agree with something does not mean that it is to be condemned. Perhaps when Dr. Northcroft will have read my paper, he may be more favorably disposed to appreciate the fundamental facts pointed out therein.

A Manual of Exodontia*

FELDMAN'S book on "Exodontia" is designed for the student and general practitioner. It presents the technic of exodontia in various types and conditions. Each tooth is carefully considered, including unusual conditions which may arise.

The writer advocates the use of the engine drill and elevator in preference to the bone chisel and mallet. This is a point which is, of course, open to discussion by oral surgeons.

The book is well illustrated and written in a very clear style. The old terminology is used instead of that adopted by the American Dental Association. The author speaks of "superior" and "inferior" teeth instead of "maxillary" and "mandibular" teeth. The old terminology of "bicuspids" and "cuspids" is used instead of the accepted form of "premolars" and "canines." Most of the illustrations have been made especially for the work and demonstrate the technic of removal of different teeth very clearly.

The book is one which can be satisfactorily studied by all men who are doing exodontia.

*A Manual of Exodontia, by M. Hillel Teldman, D.D.S., published by Lea & Febiger, Philadelphia, Pa. Price $3.50.

A REVIEW AND CRITICISM OF AN ARTICLE ENTITLED, "AN APPRAISAL OF PRESENT-DAY ORTHODONTIC PROCEDURE"*

By J. E. Taylor, D.D.S., Hollywood, Calif.

THE January number of the *Journal of the American Dental Association* contains an article which was first read at the meeting of The American Dental Association at Louisville, Kentucky, September, 1925.

The paper, entitled, "An Appraisal of Present-Day Orthodontic Procedure," while praiseworthy in many respects, utters such a note of pessimism as to warrant a more hopeful and optimistic reply.

The splendid character and eminence of the author and his high standing in the orthodontic profession give such weight and prominence to the paper that one regrets the very apparent inconsistencies and misstatements of certain parts of it.

The appraisal of modern orthodontic procedure as regards the mechanical phase leaves little to criticise. The various appliances used today are enumerated and the defects, virtues and limitations of each are carefully pointed out. When the author approaches the subject of the education of the orthodontist, however, he displays a note of vicious irritability which is not justified by the facts.

One feels that perhaps parts of the paper were written when the author was not "in his happy feelings," and that it represents merely a transient attitude of intolerance.

To quote from the paper, "It is now approximately twenty-five years since orthodontia was segregated from dentistry, and reborn, as it were, as a specialty of the latter science. For many years thereafter, the small group representing this new specialty ever held before themselves an ideal towards which they valiantly strove.

"They surmounted unbelievable obstacles and laid a foundation for a more scientific and progressive orthodontia than is in existence today."

Does the author of the above seriously believe that only the little group of men of twenty-five years ago had ideals toward which they strove and are now striving? It will be readily admitted that there was an orthodontic awakening about a quarter of a century ago, but does anyone suppose that this orthodontic renaissance period lasted only a few brief years and then passed into a dark age?

What, for instance, were those foundation stones of orthodontia, laid so securely and reverently twenty-five years ago and which have been so ruthlessly destroyed?

"Custom is the chief magistrate of a man's life," and that applies to orthodontic procedure as well as to the individual. One of the seemingly un-

*Read before the Southern California Section of the Pacific Coast Society of Orthodontists, March 11, 1927.

surmountable obstacles to be overcome by the orthodontic profession today is the customs and traditions of twenty-five years ago.

Again quoting from the paper, "We view with alarm the ever growing tendency to sweep all true principles and ideals to the winds." What, for instance, has been swept to the winds? One is tempted to ask the author to name one true principle which has been discarded. Many of the supposedly true principles of that earlier period have been swept to the winds because they were not true. The author proceeds in his attack on orthodontic educators, and asks, "Is it not in order, then, that we begin to educate our orthodontic educators?"

One naturally wonders who is going to do the teaching implied in the thought of educating our orthodontic educators. The author, however, answers that question by saying, such problems and many others could be more definitely settled by going out into the highways and byways of the orthodontic world and systematically gathering together really practical information. Perhaps if the author would locate one or more of those elusive highways, a few of us, at least a wistful remnant, with a zeal for wooing wisdom, would be happy to start out on that magic road.

To quote again, "As education is the foundation upon which progress to greater achievement is made, our institutions of dental learning should make greater effort toward acquiring a more profound knowledge of the truths of orthodontia before embarking on a course of instruction that, at present, is little more than an amazing display of ignorance." That last statement is a rather vicious indictment of the knowledge, ideals and ability of the majority of the splendid men who are teaching orthodontia in the dental colleges and postgraduate schools of America today. The proper reply should, and no doubt will, be made by the indicted and not by just a layman.

And again, "More time should be given to the investigation of the principles of tooth movement and mechanical and environmental factors, and less time to theories of a biologic nature, at least until the former have been more definitely determined." It is difficult to get the author's viewpoint here. It is not consistent with other statements in the same paper, "When it is realized that malocclusion of the teeth has been prevalent for centuries, and that it is practically inextricably interwoven with a multitude of racial faults or defects and errors of life, we can no longer hope that our problem is so nearly solved."

In other words the author admits that we have a biologic problem to deal with but advises us to devote less time to it and more time to the mechanics of tooth movement. That advice sounds like "hang your clothes on a hickory limb but don't go near the water," at least until you learn to swim.

One of the most hopeful signs of progress in orthodontia is the fact that, during the past few years, orthodontists have recognized that they have more than just a tooth problem to deal with. It is beginning to dawn on us that we must expand our local field of study to the extent of embracing the whole human organism.

"We cannot offer to the scientific world any reason for separating the

development of the body and of the bony frame in our particular field." (Howard.)

Returning to the field of orthodontic education, it will be readily admitted that the instruction given in our graduate and postgraduate schools is not all that could be desired. It will be just as readily admitted by all fair-minded men, however, that the instruction given today is far superior to the instruction given in similar schools a quarter of a century ago. Surely the graduate of a postgraduate school of orthodontia today is just as competent to practice his specialty as was the graduate of a similar school years ago.

As knowledge is a synthetic interpretation of experience, it follows that the teachers of today are considerably more competent to train men to practice orthodontia than they were in the dim past.

The graduate then, as well as the graduate today, really learns his orthodontic lessons after he leaves school. No school is able now, and perhaps never will be able, to turn out a thoroughly capable and competent orthodontist with anything like the knowledge of the experienced practitioner. It would seem to require a rather husky brand of egotism, however, to claim that the young men entering the orthodontic profession today have more "native defects" and less lofty ideals than the men twenty-five years ago.

Everything seems to point to the fact that the men entering dentistry today are better trained and at least have just as high ideals as the men of the previous period. The educational requirements necessary to matriculate are much higher, the course is two or three years longer, and the teaching facilities are much greater now than then. The student today is better grounded in the fundamentals of allied science.

It would seem unnecessary to say that his intellectual capacity and moral character have not degenerated during the past twenty-five years. The orthodontic renaissance did not end in 1902, but has continued and is gaining momentum even today.

"It has been the work of a century to change the mechanical tooth-tinker into a scientist who is concerned about his work in its health relations." (Black.)

The same thing may be said of orthodontia, except the period of development would be twenty-five years instead of a century.

When one stops to think what modern investigators have shown us relative to diet and its bearing on development in general, and specifically to the jaws and teeth, he must realize that the young orthodontist has something infinitely greater to think about than just moving the teeth around to an imaginary and doubtful line.

Increased knowledge of the endocrines and their influence on the growth and development of the body is another factor that the graduate of today learns something about, which was practically unknown twenty-five years ago.

Simon, I believe, has scientifically demonstrated that we cannot safely diagnose a case by confining our observation to that small area between the nose and chin.

Case has convinced most of us that the functional and esthetic require-

ments of certain types of malocclusion can best be obtained by extraction in some cases, rather than to attempt the ideal in all cases.

Rogers has pointed out the influences of the muscular environment of the teeth and jaws.

Mershon has shown us that moving teeth in the jaws is something vastly different from the old conception of that process.

Stallard has taught us the disastrous effects which result from abnormal and faulty pillowing habits.

Who is there to dispute that the facts, so briefly mentioned, are not of extreme value and importance; and who will deny that the young man of today, because of his increased knowledge of the influences governing diagnosis and treatment, is a more competent man to commence the practice of orthodontia than the man of the earlier period?

Everything considered, it seems to me that the young man entering the practice of orthodontia today, owing to his superior educational background, his broader knowledge of the teeth and their relationships, the increased knowledge of technical details, etc., is much better fitted mentally than was his predecessor.

It would be more refreshing for the older men of the profession to encourage the younger men, and say to them, in the language of Durant:

> "Grow strong, my comrade * * * that you may stand
> unshaken when I fall; that I may know
> the shattered fragments of my song will come
> at last to a finer melody in you;
> that I may tell my heart that you begin
> where passing I leave off, and fathom more."

BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS*

By G. F. Cale Matthews, L.D.S.

TO BE elected President of the B.S.S.O. constitutes a great honor, and I thank you most sincerely for according me this position, and crave your indulgence for any shortcomings in conduct of your meetings. Our late President earned the honor and our gratitude, by many years of hard and conscientious service as Secretary, and right well has he acquitted himself, and it is to him and the Executive the immediate Presidents must look for help and guidance.

The year of Presidency soon passes, and the influence of such an office cannot compare with that of an efficient Secretary, which this Society has had and has the very good fortune to possess. We are living in a time when the call is for Nationalism—a time when the consequences of a world upheaval have caused the nations to examine their resources—to consider the possibilities

*Transactions of British Society for the Study of Orthodontics, January 18, 1926.

of their future existence in the case of the smaller; and to put forth, in the economic struggle for existence, a wider sympathy for mankind in general.

The title of this Society was adopted by its founders possibly without any very serious consideration of its magnitude. If we consider for a moment, we shall perhaps be rather surprised at the title: "THE BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS."

If the responsibility of such a title is analyzed, we must acknowledge a very heavy one, for from the national professional outlook it must naturally be the authority which should guide and develop orthodontic practice and teaching. Fortunately for us such grave responsibility does not exist in one sense; professional practice knows no nationality—we have the advantages of international communication, the free interchange of thought and culture, the collaboration of the greatest students of research, and practical methods for the advancement of orthodontics—still, in our domestic policy, we must shape our progress. Gradually conviction is growing that orthodontics is not only a useful, but a very necessary part of dental practice; it may be perhaps excluded as dental practice and regarded as the demand for special treatment as the natural outcome of ever recurring and increasing malformations, due to causes which are being examined more carefully on the basis of scientific knowledge; and that its practice could be undertaken on a curriculum which would eliminate some of the time spent on prosthetic and conservation work—thus allowing more time to the student to perfect himself in the actual subjects more closely allied to orthopraxis.

Both our national and professional conservatism would hesitate to accept such a revolution, but I have little doubt the future must see some change in the curriculum, and possibly at a not very distant time. The present curriculum of the student is so full that the study of orthodontics is, in many cases, avoided as far as possible, and it seems impossible to allow more time; the consequence being the student qualifies with less knowledge, both practical and theoretic, in this subject, than in any other of his syllabus. And how is this to be corrected? The very exhaustive report of the Education Committee of this Society has set forth an admirable scheme for the guidance and instruction of craftsmen in orthodontics, but it is more than that: it is a guide to the schools for the instruction of students, and is so arranged that all schools of thought and practice may find assistance.

Membership of Societies devoted to branches of medical science may invoke any degree of enthusiasm from that of spectator to an earnest and active participant in its activities. It is my hope that during this coming year the active part will be taken by an increasing number, and particularly of the younger generation. It is a privilege of seniority to assume that the succeeding generation is not so alive to its duties as occasion demands, but we know that this is a characteristic grumble which has no foundation in fact. The young generation is keenly alive to its responsibilities, and happily there is a keener competition, which must make for good. Perhaps the great defect in our national professional life is the lack of competition. It is possible for the young dental surgeon to make a sufficient income despite the fact that he is educated like a K.C. and paid like a plumber, and the way can be made

easier for him by the appointments on the various clinics and the public dental service, which avoids that long period of starvation and anxiety to which so many have been subject in the past. This may militate against the further study necessary to fit a man for the specialization practice, such as orthodontics. It is the duty of such a Society as this to enthuse the younger generation until such time as the awakening occurs. The papers read here from time to time are making history; the very valuable research work revealed has already had a marked influence on orthodontic thought and procedure, but there must be no slackening in the immediate and active treatment of the patient requiring attention. Skeptical criticism and abstention of present practice will harm no one but the children who should have treatment; and we must remember that despite our acknowledged deficiencies in etiology, sufficient is known to establish a very real and helpful practice.

Nero fiddled while Rome burned; we cannot wait for all the knowledge that will doubtless come—the child must be treated. The B.D.A., as the result of Mr. Samuel's paper in May, 1925, has appointed a Committee to examine the possibilities for a scheme for the orthodontic treatment of school children, and although the report will belong to the B.D.A., both the members of that Committee and the evidence will come largely from this Society. It is possible that centralization of a Society's activities may militate against its usefulness, but that is unavoidable, and we know from many experiences, particularly the series of lectures organized by the Dental Board, how poorly special lectures can be attended. This, let us hope, does not denote a lack of interest, but a very real difficulty due to the environment of a practice and the economic problem.

The endeavor to establish a mechanical system of diagnosis which will lead to a perfect method of treatment is occupying many orthodontists' minds at present. Anthropetric measurements—cephalometric methods and apparati —muscular developments—are to give us the key to a correct solution. At present my opinion is that many abnormalities of occlusion are so influenced by heredity, environment, feeding, habits engendered by imitation, mixed racial characteristics, as to be beyond the possibility of universal treatment through any mechanical diagnostic appliances. Should such a possibility become real we should welcome it joyfully, but it suggests the mechanical humans of Karel Capek's play R.U.R.

Still we are the creatures of fashion even in our practical work—good if the fashion is a good one—the present evolution of lingual arch treatment, and the almost entire neglect of the older and well-tried methods is an example and an advance; but it requires a higher degree of skill and more experience than its predecessors, and probably another method may be evolved, which will render our present practice more or less obsolete.

If there is a note of pessimism here you must pardon me. I have personally suffered a disability which has exercised the great orthopedic minds from Hunter to the present day, and the advance has been very slight in treatment and mechanical assistance during that period. The treatment of an individual limb should be simple in theory compared to the complexities involved in a serious case of malocclusion. There is no actual analogy between

the etiology of anteropoliomyelitis and malocclusion, but both are in the sphere of orthopedic surgery; and we may still be only at the commencement of our knowledge. Our specialty is young, its advance has been very rapid, and magnificent results are being obtained, in some cases empirically (using that word in its best sense), and we look to those who have the time and research sense to advance us on the way to a truer knowledge.

It is unfortunate that the questions of nomenclature and classification have not yet been settled. It seems to me that whatever the classification adopted—either Lischer's, Bennett's or Angle's, to name only three—Angle's is the one most generally used, and it is more or less inevitable. It is difficult to depart from the early teaching. The analogy is almost that of learning a foreign language: thinking in one's own and speaking in the other until quite familiar with both. To the majority the immediate mental picture at once conjured is that of Angle's classification, and a *re*-solution from that to whatever is the chosen one, requires some effort. I would like to impress the great necessity of insisting on jaw relationships in classification, and endeavoring to establish in the minds of students a complete and definite image of the distinct variations—eliminating for the preliminary diagnosis, the individual positions of the teeth—thus establishing a correct method of, and a fundamental basis for, the fine points of adjustment in the relation of the occlusion of the teeth.

Orthodontic practice is concerned with the growth and building of the deciduous and permanent dentures and their related parts—thus it has to deal with the child. There comes again a time when all the teeth are lost and we have the edentulous mouth. Can we relate the condition of the infant maxilla and mandible to that of the aged? It would be incorrect, I think, to judge relationship from cases up to middle life where teeth have been removed unequally, and where the necessary absorption to establish the comparison has not occurred and may never do so, the study of the relation of the maxilla and mandible in the edentulous aged may be of considerable help to the orthodontist, by a comparison of what has been established and then lost. There is permanent forward growth of the bone remaining, but the alveolus has been absorbed—which brings the condition to the same relationship in comparison to the general growth of the head and face. While an establishment of occlusion will have resulted from the presence of the teeth, on their subsequent loss that occlusion must be accurately reestablished if the patient is to be comfortably fitted with artificial substitutes. We know how difficult this may be. This thought has no claim to scientific orthodontic usage. It will be found that the same condition remains in the relation of the edentulous as existed in the complete denture whether it be normal, distal or mesial, and that the articular relationship will remain stable. Due allowance must be made for the development and retention of feature prominence or otherwise, which may or may not have responded to the dental development.

Much work and study remain to be done in the etiology of malocclusion, and foremost in this work I would place heredity. Confusion is growing around the terms of heredity and environment; they may be taken together and their combined significance duly noted, but they should remain separate

and distinct units of comparison for the dissection of essentials. The outstanding indication in the historical evidence of heredity is so frequently quoted from the Hapsburgs and Bourbons—in the one case the lower lip, and the other the nose. Those are the evidences which are obvious and revealed, but there may be others which could only be recorded by an examination involving both detailed and private research.

The student of orthodontics, after his curriculum is completed, may direct his attention to many studies: the anatomy of the parts, the etiology, the quest in diagnosis for the treatable—and ultimately the practical solution of the problems presented. Unfortunately, it may be his inclinations and opportunities do not lie in the direction of these advances, and circumstances may so tend that they shall be taken in an inverse order. The artistic side of our work does not receive the attention it deserves in discussion at meetings. The general and almost universal procedure is one of pure mechanical knowledge and activity, whether that be muscular or technical.

There is another side which should be cultivated—a side which must be helpful—the truly artistic appreciation of nature, whether it be in the human development or in the limitless field of nature; it will widen the powers of observation and help in the relation of values. A musician would not attempt to write a symphony until he had mastered the elements of harmony, counterpoint or orchestration. The artist will study in detail the subject he wishes to describe in color; sketches innumerable may be necessary before he is satisfied that his resulting picture will describe his subject correctly, not only in drawing but be true to form—values correctly related.

The great artistic masterpieces of the centuries have all one outstanding feature: they are true in tone, they convey a sense of harmony, and they exhibit a profound and keen observation. We are not all of us gifted with the artistic sense—we may have no musical sense or artistic perception, but we can all encourage the faculty of observation; and I do commend to those who have any desire to become proficient in the art, for art it is, of orthodontics, a study of the beauties of art and nature. The great galleries are full of lessons for us. We see through the centuries the gradual change of facial development, the change of facial depiction of national characteristics, and we can add to our anatomic studies and knowledge the additional fact that heredity and environment do make changes of expression through time and circumstance. We must, however, be always on our guard to make proper allowances for fashion.

From time to time there are indications of a sincere desire for increased instruction by postgraduate work. While this method of teaching has great popularity in the U.S.A., it seems to be against our national inclination to acknowledge the necessity for further instruction once the hall-mark of qualification is obtained. Why is this? The answer is a difficult one, and I find myself back again at the "competition" stage.

If postgraduate work is not a necessity it cannot be a success; the combination of a few earnest students in a request for such courses will make for efficiency and knowledge in both student and teacher; but its efficiency must

be based on a proper appreciation of its value, and it must be a properly remunerated course of instruction.

The many varied postgraduate courses in America cost as much for three months' training as the whole of our curriculum fees in many cases, eliminating the mechanical training. Not only are they fully attended, but the student is expressly reminded that he will need much clinical experience before he should embark on practice.

This coming summer those of us who go will have opportunities in the International Congress of judging how comparable are the methods of teaching in the ordinary curriculum; but unless we adopt some further instruction than can be given during the present studentship it must be a long period between qualification and successful orthodontic practice for many. Can the B.S.S.O. initiate any such courses? Can the attendance at such courses be a recognition of capacity? Such an acknowledgment of capacity will be advantageous to all concerned—it would enable the orthodontic practitioner to have his cases inspected, and appliances adjusted by others with confidence that a clear understanding existed as to diagnosis and treatment of that particular case.

A Presidential Address should have a note of originality. It was my hope to present to you some records of comparison in feeding and malocclusion: this proved a greater task than I anticipated, and so far the figures obtained would not justify publication. The results aimed at are the definite establishment of prenatal feeding effect on bone formation, and the comparison of all classes of the community from the frugal, bare necessities to luxury in feeding. The general history chart of the B.S.S.O. does this from one to six years with the child, but I wish to carry this further to the parental responsibility. It is proving a tremendous task, and may take some years to establish any reliable relationship.

Extra orthodontic education consists of two principal factors: the education of the parent and the education of the public authorities. The number of children who would benefit by some thoughtful treatment varies according to various writers. Mr. C. E. Wallis states that 2 per cent of the children in the London school area need treatment. Mr. Norman Bennett gives the figures as 9 per cent needing simple treatment, in his Report to the Ministry of Health. Mr. Jones, the Dental Officer of Staffordshire, gives 6.6 per cent. If we take an average of these figures and accept 5 per cent as a fair basis from the official standpoint, and a low estimate of 500,000 children, we have the appalling figure of 25,000 children needing orthodontic treatment, in the number of children who come under the dental officers' care for examination and treatment for caries, etc. This does not include the great number who are both too young and too old for dental examination. The figure of 5 per cent is by no means a fair proportion based on one's clinical experience. The figure must be based on a broad appreciation of malocclusion, and if so, would probably be between 30 per cent and 40 per cent. But if you allow 25 per cent we have over 100,000 children needing attention in London alone. At present these children go untended by any authority—the schools do their best—it is a mere drop in the ocean of responsibility. In the past there has

been some excuse for this neglect: lack of dental surgeons willing to do the work, a misgiving as to its practical outcome, and lastly the cost. Expense of public treatment must always be considered, and it never grows less. The other difficulties, lack of dental surgeons and the doubt of successful practice, do not exist in anything like the same degree. I am assured that many of the school dental officers would welcome the opportunity of being allowed to do orthodontic work, and the increase of young practitioners should supply an efficient service, and the results should more than justify the cost. I was interested to read the remarks of that amusing and cultured writer, Mr. E. V. Lucas, in an article in the *Sunday Times* of December 13th last, "American Notes from a Wanderer's Note Book."

"In every city that I visited—whether New York or Pittsburgh, Cincinnati or St. Louis—I was struck by the prettiness of the girls and the excellence of their clothes. In New York there are more of them, that is all; in the other cities the standard of dress is as high. . . . And how refreshing it was to find girls with chins once more, after our prevailing English type, where in accordance with I know not whose dictates, the chin has for so long been removed."

This remark from a layman, in reference to the revival of the chin, is interesting. It is a remarkable statement from the orthodontist's point of view. We know that distocclusion is a very common form of malocclusion in America, as frequent as in this country probably, and yet to the casual observer the chin is reappearing in the American girl. If this is the result of orthodontic treatment as practiced there it is a compliment to our specialty and American colleagues, and it behooves us to examine this in a more scientific way. Nevertheless, it should be noted. Can the B.S.S.O. give any assistance to the nation in dealing with a subject so vital to its health and beauty? I venture to think so, but it must be approached in a spirit of sacrifice if embarked upon. As I have said earlier in these remarks, the suggestion is made from time to time that postgraduate courses should be available in orthodontics. Some such courses have been held, and with some good results to those attending, if only to give them a knowledge in the time sufficient to enable them to view the subject in a different light to that gained in a compulsory syllabus as students. Every recruit is to be welcomed, but it has hardly touched the fringe of the subject. For one reason, the courses are usually given by one individual. It is difficult for a single lecturer or operator to teach in a course of twenty hours (ten lectures so-called) a subject with so many ramifications as orthodontics. We know, from our experience in this Society, how popular an evening devoted to practical demonstrations is, and interesting and instructive they are, but that is the great danger in orthodontic teaching: the fascination of beautifully designed appliances must appeal to the mechanically trained sense of the average dental surgeon, and having assured himself that an appliance can accomplish a certain movement he may be impelled to employ it without having fully acquainted himself with its possibilities, sometimes to his great disappointment.

To the student and practitioner of orthodontics, I venture to suggest many things evolve from a subconscious familiarity, in other words, experience and

skill—two things it is impossible to teach. I find in conversation with orthodontic practitioners of renown that their practice has generally been built upon a solid foundation of general practice, and that the specialization has come along with, and after many years of, such experience. Our national characteristic of caution and compromise has, during the past twenty years, allowed us to gather a fund of knowledge, sometimes at the expense of our more enthusiastic and venturesome brethren, to whom we are indebted for the opportunities afforded us. No one, today, would venture to allow to a universal application of an individual appliance, the possibility of correction of all types of malocclusion, yet such claims have been made for many forms.

The work of the B.S.S.O. is varied. It has its purely academic interest as evinced by the high standard of its papers of great scientific value, which will gradually give authority to treatment. It has its educative side in that we all as members must benefit by our mutual association and exchange of thought and practice, and it has its still further sphere of usefulness in that its transactions are freely published for the benefit of humanity in general. But neither the academic interest or educative value should be the total asset to the nation of a Society such as this. Being the only Society in the British Isles devoted to the study of orthodontics, I venture to suggest to you a scheme which should add much to our knowledge and materially add to our national welfare. One can assume that it is impossible for our schools with their honorary staffs to undertake the task of postgraduate orthodontic teaching. It is also recognized that the students' curriculum is fully loaded. It is a fact that there is a sufficiency of able and earnest teachers if the occasion arises. It can easily be ascertained if there is a probability of a genuine desire for this teaching. The clinical material is available and demanding treatment, and would be passed through the school clinics only. London should be the center for such work. I would like to see a permanent school devoted to the teaching of orthodontics established; facilities should be granted to enable it to become firmly established. It should be enabled to grant a diploma of proficiency to those students fulfilling the requirements of its syllabus and examinations, and it should be established under the auspices of the B.S.S.O.

CONSCIOUS CONSTRUCTIVE APPLICATION OF PRESSURE*

By R. E. Irish, D.D.S., Pittsburgh, Pa.

IF IT were possible at present to understand all of the intricate workings of nature, and analyze her transitory stages from the point of inception of an individual through life to the moment of death, then we unquestionably could, as a result of our findings and a knowledge of the same, accept a form of treatment necessitating only its application for an absolutely accurate result.

Considering what the future will bring forth, we should accept our treatment of today, not with absolute satisfaction as regards its working principle, but only for its worth in a critical way, with hopes of what research of today and the future might reveal.

Some one has said that the most successful treatment for an affliction is prevention, which is a true statement; but prevention is gained by a knowledge of the cause and combating it. To date nature has not allowed us full control of her master key, which would make possible the opening of all her doors to progress. Therefore we must continue seeking the cause for prevention and assist in development towards the normal. We must realize we are living in a small dimensional space, with a problem and its solution confronting us.

Energy is constant. It changes only its form. Are we always conscious of this fact? I believe not. How often in our work have we been hasty in our application of energy, or perhaps I should say, in the application of its change in form? Pressure is a form of energy. Are we always conscious of its application in treatment, of the change histologically and physiologically of tissue, i.e., hard and soft, from our form of energy, i.e., pressure?

We are dealing, fellow practitioners, with microscopic structures.

Inanimate structures can be shaped almost as desired, but animate structures as applied to the human body, we must remember, offer a different problem. Nature deals in transitions rather than straight lines. If we are sincere, should we not then remember to be constructive in our application of pressure? It is possible to be conscious of pressure but not constructive in its application. If we are not conscious and constructive we are working towards one end only, i.e., destruction.

In our application of pressure, if we remember that action and reaction are equal and opposite (associate this fact with a knowledge of the histologic and physiologic change of tissue incident to tooth movement), we unquestionably are working in the positive. If an inequality is present, it should, for successful treatment, favor the positive rather than the negative.

*Presented as a clinic before the First International Orthodontic Congress and later in the form of a paper and demonstration before the New York Society of Orthodontists in October, 1926.

Let us now consider application, for without application in an associated manner, realities cease to be. If we are to correct any form of inequality, we must thoroughly, consciously, and constructively apply our treatment. We

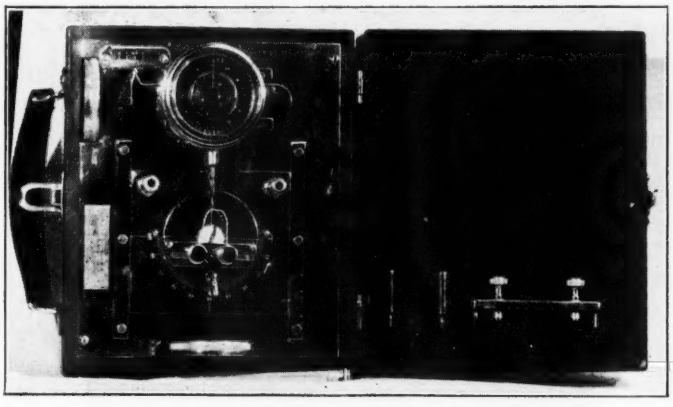

Fig. 1.

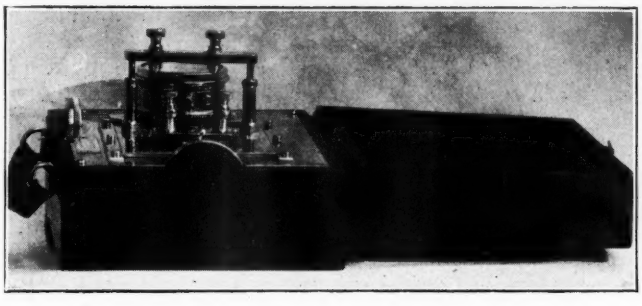

Fig. 2.

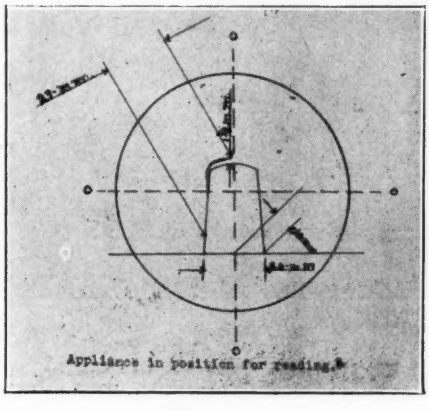

Fig. 3.

must have a knowledge of the working principles, select our form of treatment, and be ever conscious in its application.

Thus far, what we have mentioned, we cannot fail to consider as primary factors unless we are working in the negative rather than the positive.

In our treatment of today, mechanics play a great part towards accomplishing an ultimate result, and for this reason pressures enter our field

of treatment from every angle, so interwoven that without pressure we are lost.

It is not a very great problem to move animate or inanimate objects; but to move them in a constructive way, i.e., in the positive, offers a very great and delicate problem.

A force, we know, is any cause that produces an operating energy. The energy of a force, as applied in orthodontia, we speak of as pressure. It, in

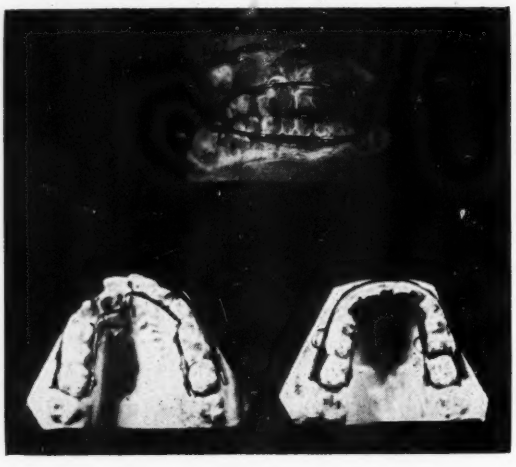

Fig. 4.

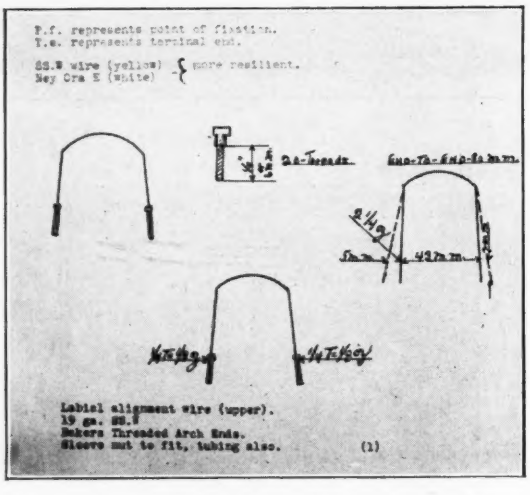

Fig. 5.

turn, is responsible for histologic and physiologic changes, incident to tooth movement.

The perception of all movement is time and space. Our change then, as result of pressure, requires time. As a result of time and pressure, we create change of tissue, i.e., histologic and physiologic, in the form of space; and in our created space, nature reconstructs in the normal.

Even with our knowledge of pressure and its conscious constructive application we are at a loss, for to date, the exact physiologic change of the stimulation process is unknown.

It is readily conceivable why many injurious changes in tissue take place, when, as you will see, many of our adjustments of auxiliary springs and base wires, as regards pressure, have been very great and therefore drastic in their action.

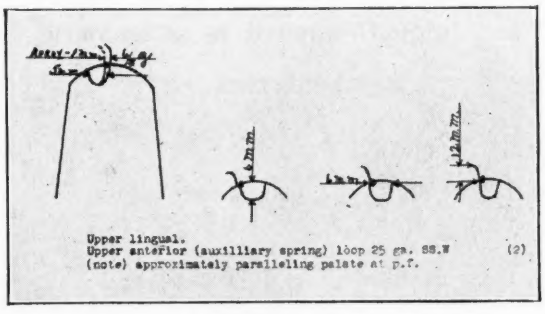

Fig. 6.

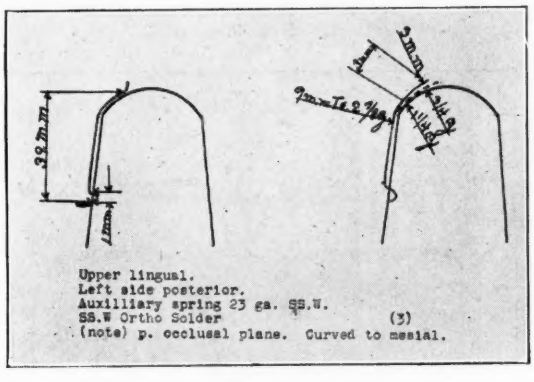

Fig. 7.

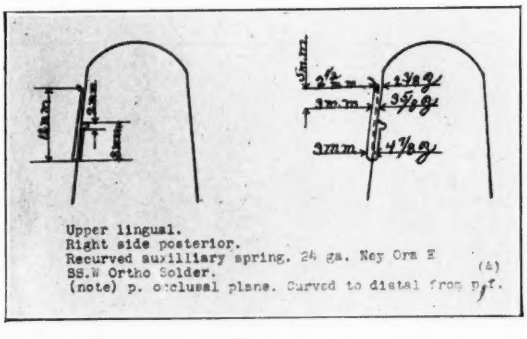
Upper lingual.
Right side posterior.
Recurved auxilliary spring. 24 ga. Ney Orm E
SS.W Ortho Solder. (4)
(note) p. occlusal plane. Curved to distal from p.f.

Fig. 8.

It is not my intention to put in writing all I am presenting, therefore in conclusion and in summarizing, may I enumerate what I believe are primary considerations of "Conscious Constructive Application of Pressure," as mentioned in my paper?

1. Nature deals in transitions rather than straight lines.
2. Action and reaction are equal and opposite.
3. Perception of all movement is time and space.
4. The exact physiologic change of the stimulation process is unknown.
5. We must be considerate of pressures at work.

Accept, not as final, but as an aid in treatment and a means of furthering discussion of a constructive nature, my presentation today.

Let us all have the right concept, and emancipate potential thought.

The photographs presented (Figs. 1, 2, 3, etc.) are for the purpose of showing variance of spring pressure as regards auxiliary springs and base wires (both labial and lingual) applied in orthodontic treatment.

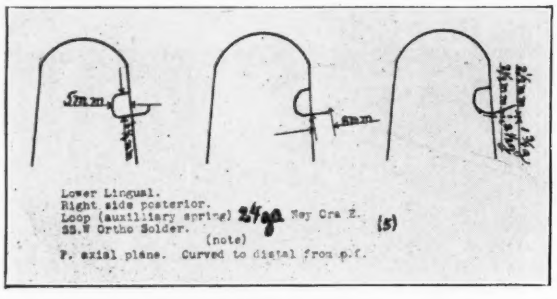

Fig. 9.

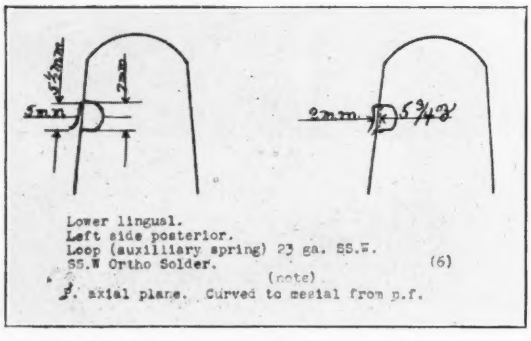

Fig. 10.

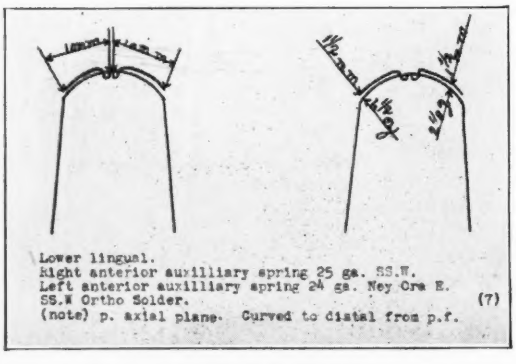
Lower lingual.
Right anterior auxilliary spring 25 ga. SS.W.
Left anterior auxilliary spring 24 ga. Ney Cra E.
SS.W Ortho Solder. (7)
(note) p. axial plane. Curved to distal from p.f.

Fig. 11.

Fig. 1 represents a top view of Irishometer, showing a lingual appliance in position for reading.

Fig. 2 represents an end view of Irishometer with the standards in position for recording the upward or downward pressure of a labial or lingual appliance.

Fig. 3 represents drawing, showing relative position of appliance to instrument for auxiliary spring reading, either anterior or posterior. A lateral

reading may be recorded by rotating table on which appliance is fixed and releasing one end of base wire.

Fig. 4 shows appliances in position on upper and lower models. The appliances shown here are labial and lingual, having, as you note in Figs. 5,

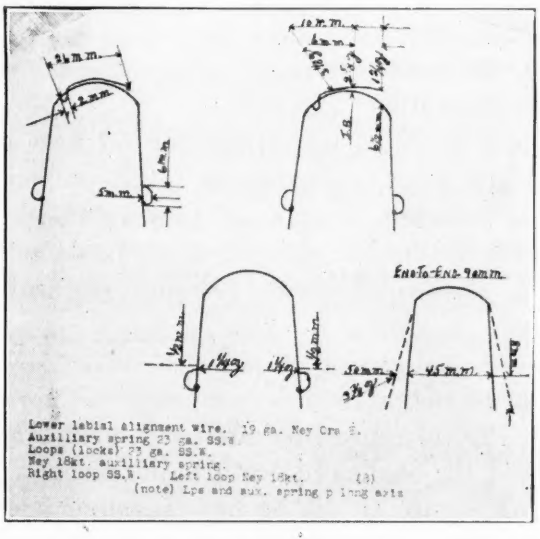
Lower labial alignment wire. 19 ga. Key Cre
Auxilliary spring 23 ga. SS.W
Loops (locks) 23 ga. SS.W.
Key 18kt. auxilliary spring.
Right loop SS.W. Left loop Key 18kt. (3)
(note) Lps and aux. spring p long axis

Fig. 12.

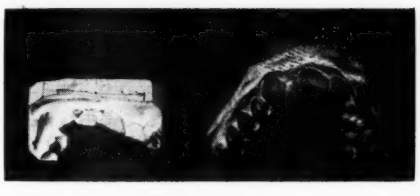

Fig. 13.

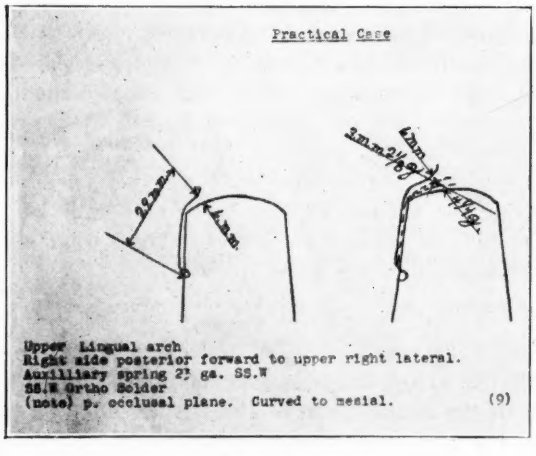
Practical Case
Upper Lingual arch
Right side posterior forward to upper right lateral.
Auxilliary spring 23 ga. SS.W
SS.W Ortho Solder
(note) p. occlusal plane. Curved to mesial. (9)

Fig. 14.

6, 7, 8, 9, 10, 11, 12, different types, gauges (thousandths), auxiliary springs, Baker's threaded arch ends, and different makes of wire. The appliances shown in Fig. 4 contain different types of auxiliary springs represented in Figs. 6, 7, 8, 9, 10, 11, 12.

Figs. 6, 7, 8, 9, 11, 12 represent various types, gauges (thousandths), makes of wire, and various types of auxiliary springs from which readings were taken as presented. All readings of auxiliary springs in Figs. 7, 8, 11, 14 were taken at a point immediately beneath the base wire, having an original position a number of millimeters away from the base wire as shown. In these figures you will note that, where more than one reading of an auxiliary spring is taken, the same was taken at its terminal or free end in the direction of its point of fixation.

Fig. 5 represents a recorded lateral pressure of base wire and pressure of Baker's threaded arch ends, representing ⅛ oz. pressure to ¼ turn.

Fig. 6 represents recorded pressure of loop auxiliary spring as shown. Direction of pressure is backward (away from median line).

Fig. 9 represents recorded forward pressure (toward median line) of loop auxiliary spring.

Fig. 13 represents photograph of practical case showing models with upper right lateral in lingual occlusion (version), and correction of same as result of treatment. Fig. 14 represents auxiliary spring reading or recorded pressures which caused the change of tooth position.

In Figs. 5, 6, 7, 8, 9, 10, 11, 12, 14 note wording mentioning materials used; gauge (thousandths), make of wire, solder used, type auxiliary spring, etc.

As regards my presentation, discussions may be many, but unquestionably a knowledge of pressure is necessary for constructive treatment.

DISCUSSION

Dr. Stanton.—I want to endorse any movement that brings to a definite basis the forces applied to teeth. I have noticed in my own experiments that as the size of the wire increases the force is also increased out of proportion to the increase of size of wire. If you double the size of the wire you increase the force four times. In other words if you double the gauge of the wire, the force is increased to the fourth power. This follows a definite law known in engineering as Hookes Law, and by it you can determine what amount of pressure can be put on a tooth comfortably. With a 19 gauge lingual arch deformed 5 mm. you will exert half a pound of pressure which will be tolerated without inconvenience in some cases. Other patients will react decidedly against so much pressure. Some patients may tolerate 8 ounces of pressure, and another child may not tolerate more than one ounce. A simple way of measuring the amount of force is to take your wire and lock it securely on one end, then put a weight on it—and the extent to which that weight deforms the wire will give you an accurate measure of the force applied.

Dr. Irish should be encouraged in his efforts to produce a standardized instrument for orthodontists.

Dr. Ferris.—I would like to ask Dr. Irish whether he has noticed any change in pressure as the tooth moved towards the resting point? There is a certain initial pressure on a given sized spring, but there is a perpetual pressure according to the molecular value, and the gauge of the wire. The smaller size wire reduces its initial force sooner than the large size wire with the same set of spring, and a greater expansion of the spring from its resting position is required to accomplish the same total movement of the tooth.

Dr. Waugh.—These measurements are extremely interesting and have long been needed in orthodontia. I would like to ask for general information regarding the best size of auxiliary spring wire to be used. In other words, I am using 0.022 of a certain wire—some

men use as low as 0.016. I do not use these smaller sizes because they are bent out of shape too easily in the mouth. I should like to know what size Dr. Irish would advise for general work in the mouth of the average child. I know that it is sometimes necessary to use heavier wire, in cases of adult patients, etc.

Dr. Hawley.—This demonstration is exceedingly interesting from the theoretical viewpoint, but there are some factors, when you apply this to movement of teeth, which interfere with accurate estimate of the amounts of pressure to be used—teeth respond differently—age of the patient influences it—and you have to come back to judgment based on experience. Another question is—how much of this pressure in the anterior portion of the mouth with the auxiliary springs upon an inclined surface—how much force that is exerted results in movement in a labial direction. If you put a force upon an inclined surface you have two resultants—one forward, the other upward. That is illustrated best in the example of a sailing yacht. It is common knowledge that you can tack—and move a vessel forward against the wind—here is the bow of the boat—here is the sail—force against the sail will move the boat forward—one resultant of that force is forward—the direct force meets resistance in the shape of the boat. It has been my experience that these wires upon the slanting surface of the upper teeth will intrude the teeth. It is because one resultant is upward—and the other is labial. The labial resistance is stronger than the intrusive. That is one reason why we notice intrusion of the teeth. A tooth intrudes more easily than it moves labially. For instance, you put an auxiliary spring on the mesial surface of a premolar—one result of the force extrudes the tooth, because it is working on a slanting surface. I do not like auxiliary springs on the inside of the maxillary anterior teeth unless I want intrusion. If the case verges towards an open bite you make matters worse. In case of these wires on slanting surfaces of incisors the labial resistance is greatest and consequently you cause intrusion. I think these results interfere with practical application of these experiments. It is all very interesting and we have always recognized the fact that the longer the spring the larger it must be to deliver a certain force, but you cannot apply these results in practical work.

Dr. Ferris.—In answer to your question I will state the readings were original, taken at a point or points along the wire from its free end to the point of fixation. The readings were taken from a point (or points) forward from the base wire to a point immediately beneath the base wire.

It is so that there is a variance of pressure, as the teeth move in their line of travel.

Dr. Waugh.—I cannot definitely answer your question, but will say as result of observation to date, that I prefer auxilliary springs of a finer gauge i.e., 0.018 or 0.016. That is, I prefer the finer type auxiliary spring.

Dr. Hawley.—I do not believe, as Dr. Hawley, that the application of pressures as read is impractical, for the reason they are not applied as Dr. Hawley questioned.

If as a result of recorded readings and observation, we can compile a table of pressures, of different types, makes, thousandths, lengths, etc., of auxilliary springs and base wires; associating the above mentioned facts with distance and pressures we unquestionably have a better working knowledge.

In answering Dr. Hawley concerning the intrusion of teeth as result of auxiliary spring pressure as mentioned, I cannot appreciate the application and result in the same sense.

(1) AFTER-RESULTS OF CASES TREATED ABOUT TWENTY-FIVE YEARS AGO. (2) AFTER-RESULT OF CASE TREATED SEVENTEEN YEARS AGO*

By Dr. Horace L. Howe, Boston, Mass.

Fig. 1. *A, B, C.*—Case 1. F. C., 1900.

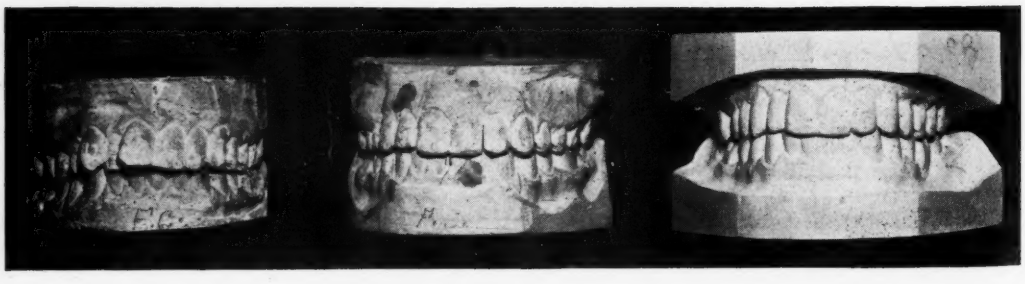

Fig. 2. *A, B, C.*—Case 1. F. C., 1901.

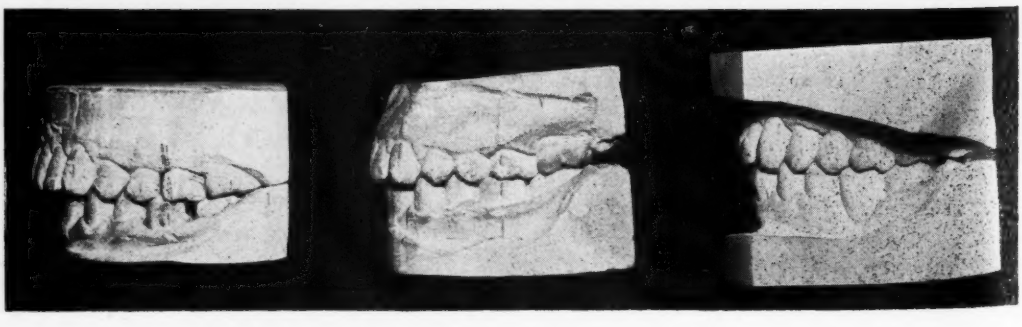

Fig. 3. *A, B, C.*—Case 1. F. C., 1926.

*Clinic before The First International Orthodontic Congress, New York City, August 16-20, 1926.

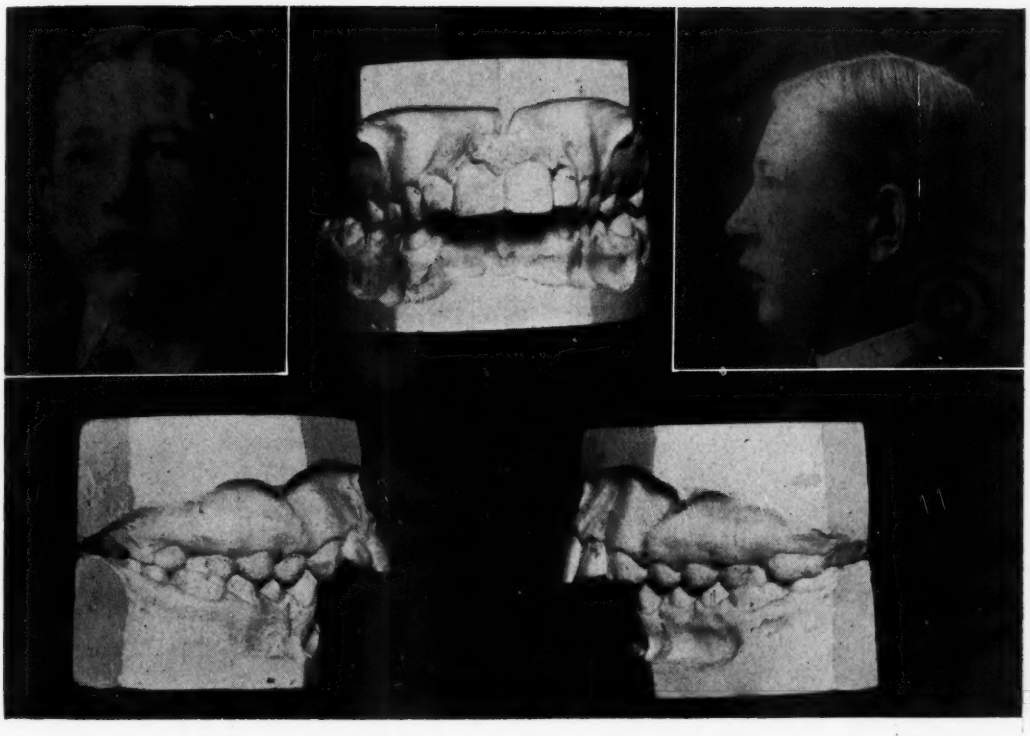

Fig. 4.—Case 2. M. S., 1903.

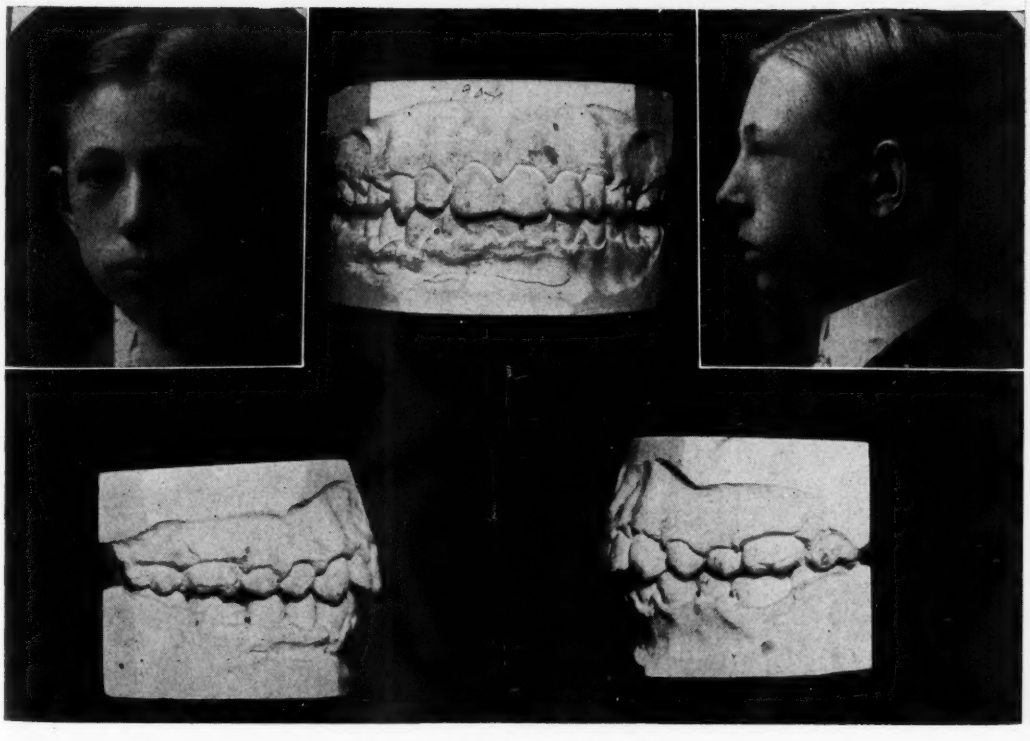

Fig. 5.—Case 2, M. S., 1904.

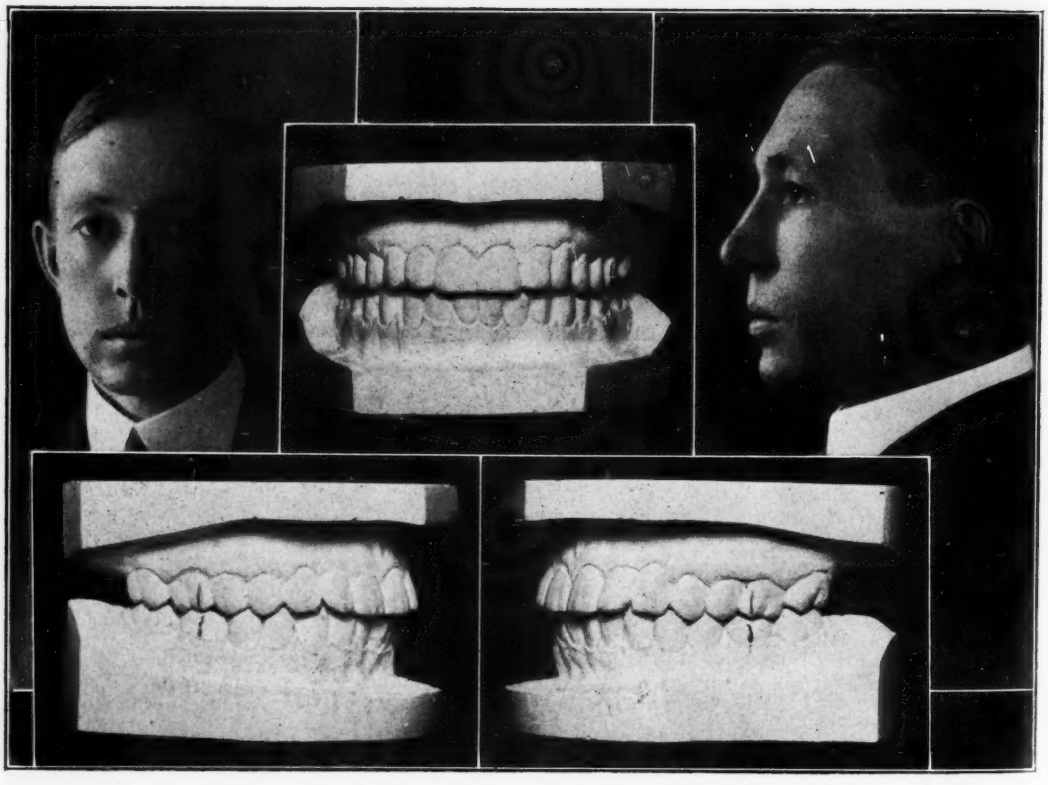

Fig. 6.—Case 2. M. S., 1922. Seventeen years after all retaining appliances were removed.

CONGENITAL HARELIP AND CLEFT PALATE—CASE I*
(Unfinished Case)

By Dr. Walter Coolidge Chapin, New York City

Patient: Boy, brother of Case II.
Age: Eleven years.

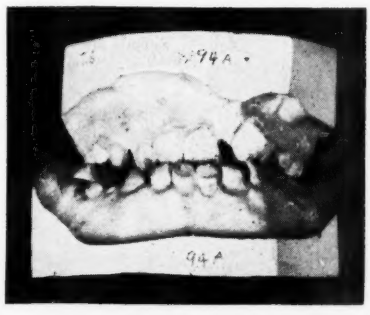

Fig. 1.—Front view before treatment.

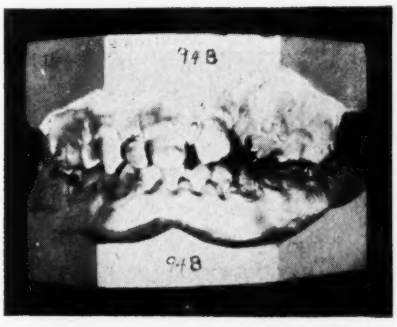

Fig. 2.—Front view after eighteen months of treatment.

Fig. 3.—Side view before treatment.

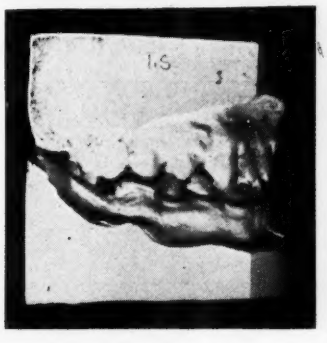

Fig. 4.—Side view after eighteen months of treatment.

Fig. 5.—Occlusal view before treatment.

*Given before the First International Orthodontic Congress, New York City, August 16-20, 1926.

Fig. 6.—Front view before treatment.

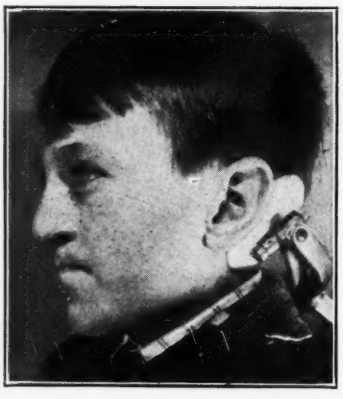

Fig. 7.—Profile view before treatment.

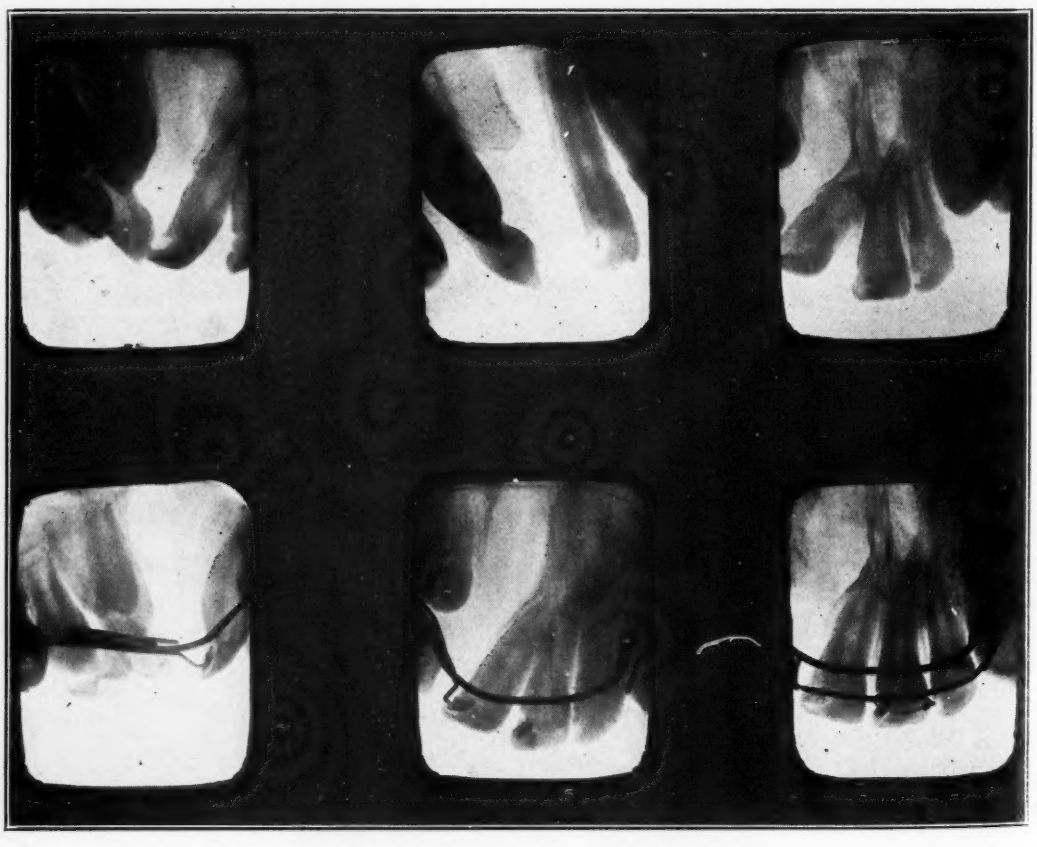

Fig. 8.—Radiograms showing conditions of bony structure.

Length of time of treatment: Eighteen months.
Congenital harelip. Left side.
Congenital cleft palate. Left side.
Conditions not traceable to heredity.
Harelip operation in Texas at age of one month.
Cleft palate operation in New York at age of five years.
Missing tooth: Left maxillary lateral incisor.

Fig. 9.—Profile view before treatment showing occlusion.

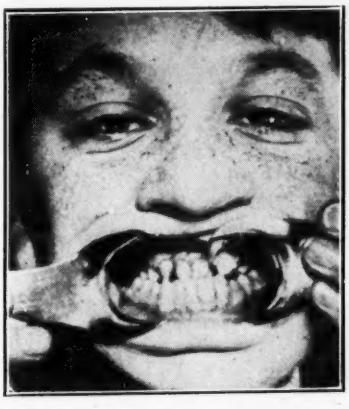

Fig. 10.—Front view before treatment showing occlusion.

Fig. 11.—Occlusal view after eighteen months of treatment.

Treatment:

Simple upper lingual arch appliance with attached finger springs for moving the anterior teeth labially.

Plain upper labial arch appliance used in conjunction with wire ligature.

Plain lower labial arch wire with intermaxillary hooks for attaching intermaxillary rubber elastics.

Plan for completion:

Movement of teeth to correct positions.

Insertion of plate which will act as a retainer and which will supply the missing teeth.

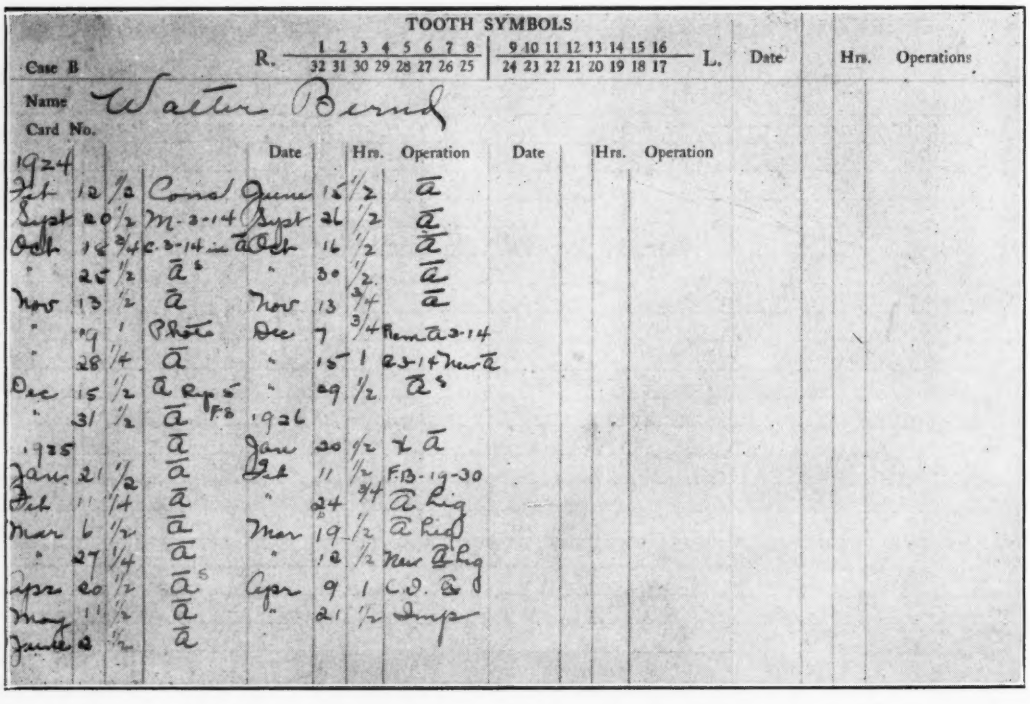

Fig. 12.—Record Card showing date of visits and operations.

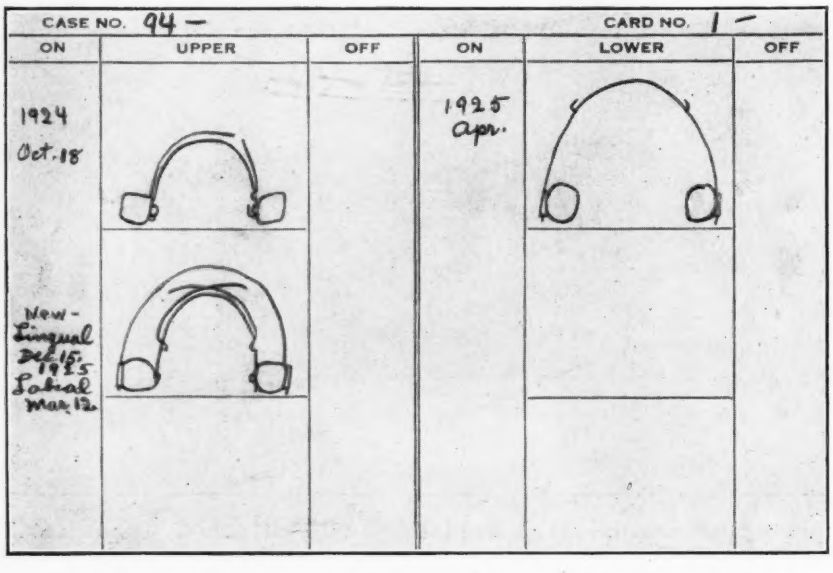

Fig. 13.—Appliance Chart showing type of appliance employed.

CONGENITAL HARELIP AND CLEFT PALATE—CASE II*
(Unfinished Case)

By Dr. Walter Coolidge Chapin, New York City

Patient: Boy, brother of Case I.
Age: Nine years.

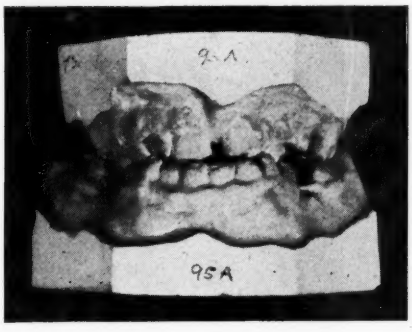

Fig. 1.—Case II. Front view before treatment.

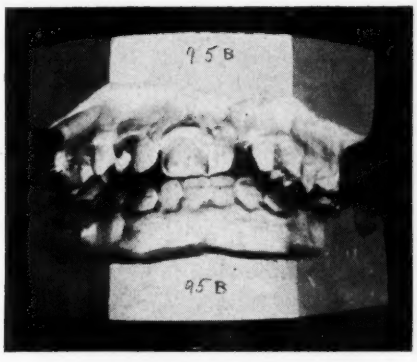

Fig. 2.—Case II. Front view after eighteen months of treatment.

Fig. 3.—Case II. Side view before treatment.

Fig. 4.—Case II. Side view after eighteen months of treatment.

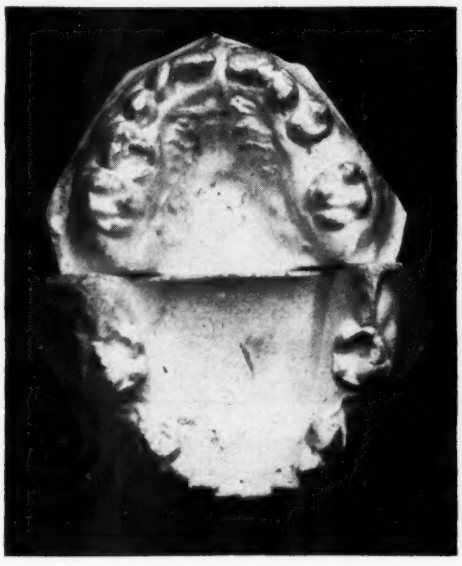

Fig. 5.—Case II. Occlusal view before treatment.

*Given before the First International Orthodontic Congress, New York City, August 16-20, 1926.

Fig. 6.—Case II. Front view before treatment.

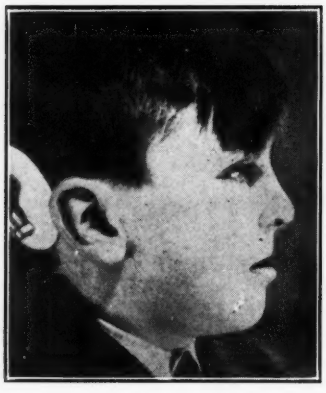

Fig. 7.—Case II. Profile view before treatment.

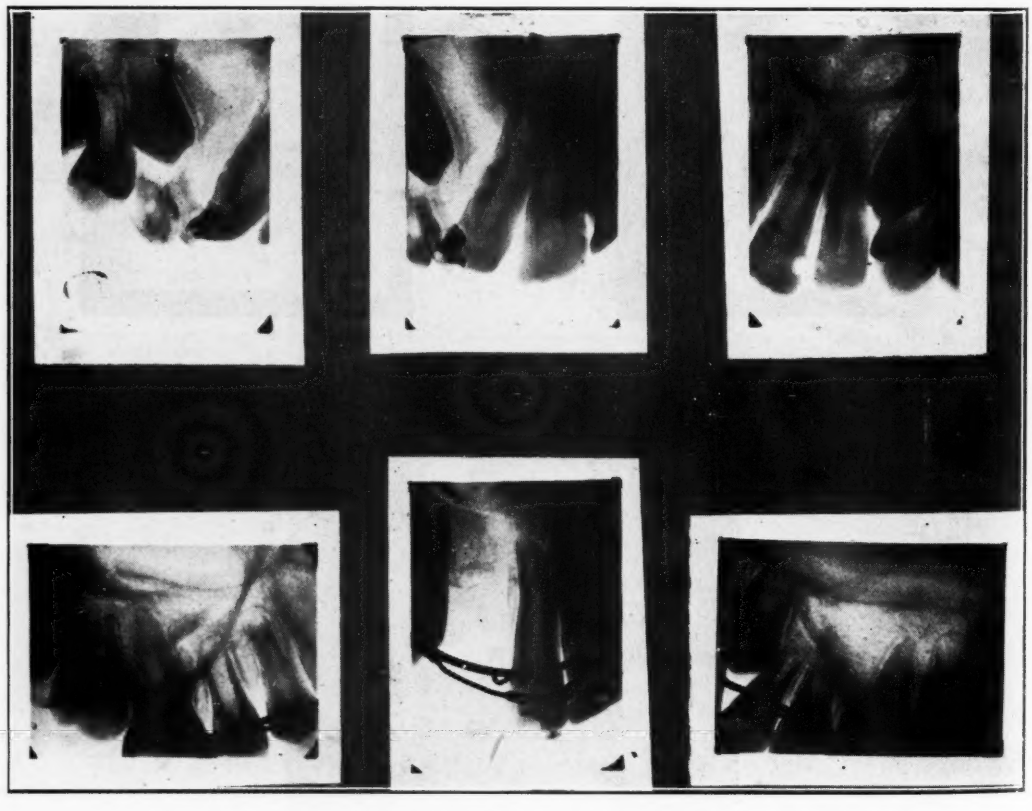

Fig. 8.—Case II. Radiograms showing conditions of bony structure.

Length of time of treatment Eighteen months.
Congenital harelip. Left side.
Cleft in bone, but not in soft tissue.
Conditions not traceable to heredity.
Harelip operation in Texas at age of one month.
Missing tooth: Left maxillary lateral incisor.

Fig. 9.—Case II. Profile view before treatment showing occlusion.

Fig. 10.—Case II. Front view before treatment showing occlusion.

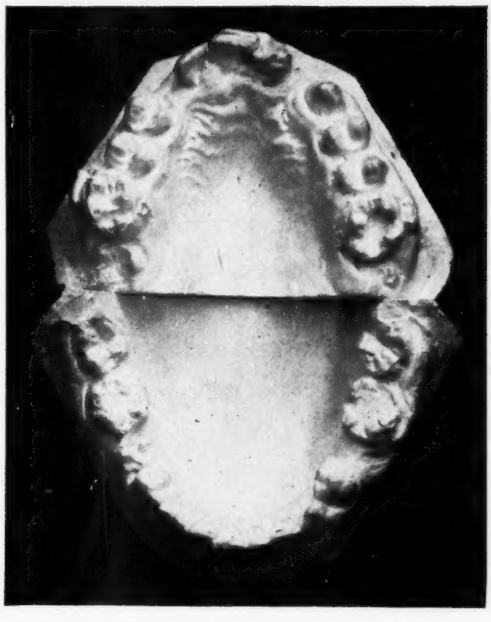

Fig. 11.—Case II. Occlusal view after eighteen months of treatment.

Treatment:

Simple lingual arch appliance with attached finger springs for moving the anterior teeth labially.

High labial arch appliance with spring extensions for opening up the space necessary for the incoming permanent right maxillary canine.

Plan for completion:

Movement of teeth to correct positions.

Insertion of plate which will act as a retainer and which will supply the missing teeth.

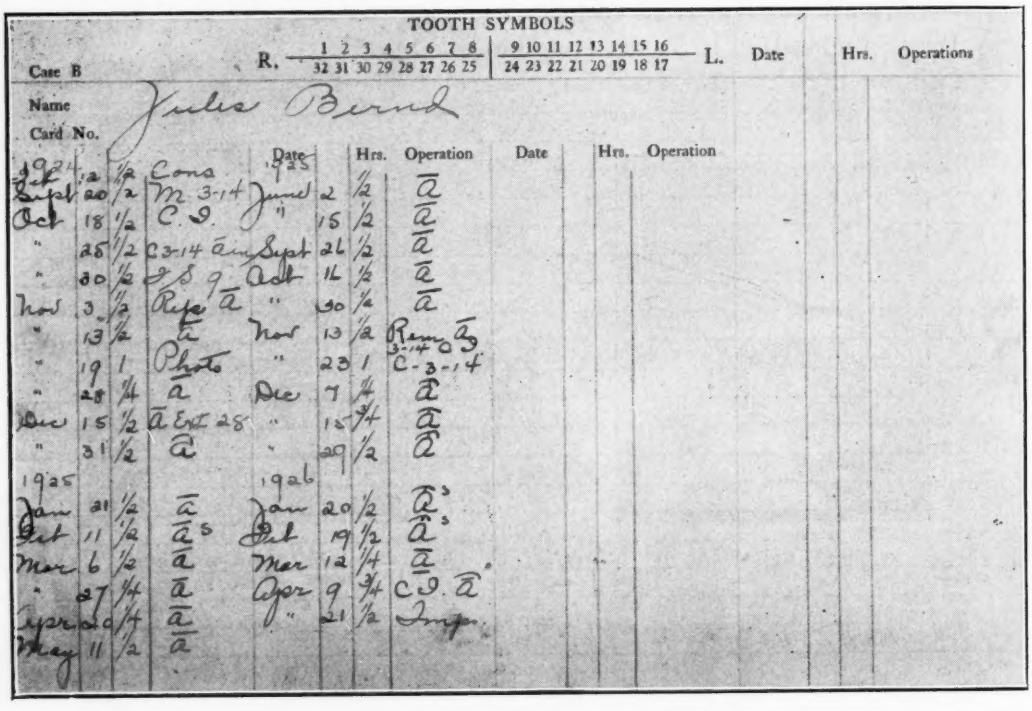

Fig. 12.—Case II. Record Card showing date of visits and operations.

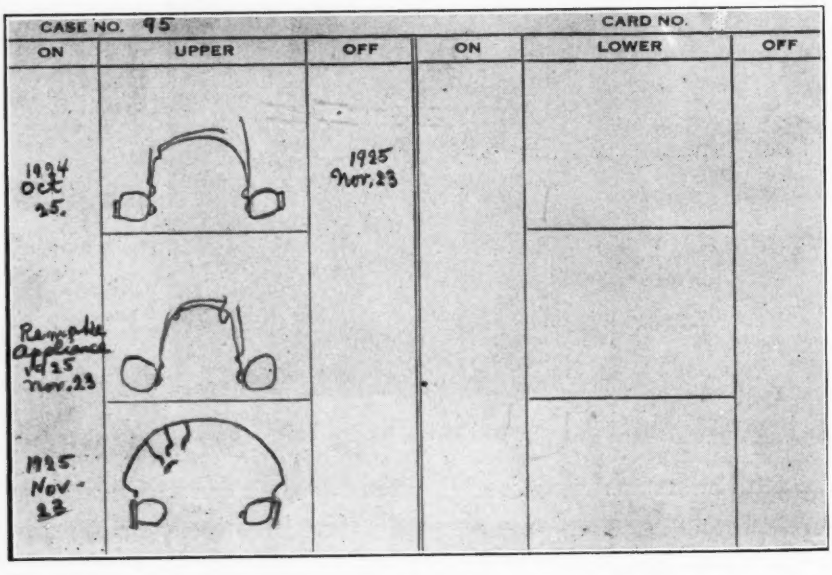

Fig. 13.—Case II. Appliance Chart showing type of appliance employed.

ABSTRACT OF CURRENT LITERATURE

Covering Such Subjects as

ORTHODONTIA — ORAL SURGERY — SURGICAL ORTHODONTIA — DENTAL RADIOGRAPHY

It is the purpose of this JOURNAL to review so far as possible the most important literature as it appears in English and Foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Factors Influencing Mouth Conditions During Pregnancy. J. M. Gompertz (New Haven). Dental Cosmos, October, 1926.

This report is made from the Prenatal Dental Clinic of the Yale University School of Medicine. The causes of caries in pregnancy or rather the factors which increase the incidence of the disease at that period have never been understood although it has been easy to surmise that the growing fetus deprives the maternal organism of some of its due. The author has endeavored to shed some light on this difficult problem by means of an exhaustive analysis of all buccal conditions during gestation. He has now followed up 200 of these cases. Some of the data obtained were negative but some information was gained, such as the fact that inferior nutritive conditions exert some influence on the increase of caries while foreign born women (from Southern and Eastern Europe chiefly) suffer less than American women despite their low social and economic status. This may possibly be due to the fact that foreigners eat far more vegetables and less meat than the native stocks. All of the women are requested to nourish themselves as follows: one daily quart of milk; an orange and a salad; at least one green vegetable to add to the potatoes; meat, fish or poultry but once a day; six to eight glasses of water; one cup each of tea and coffee. There should be three daily meals while the milk can be drunk between meals. The object of the milk and green vegetables is to make sure of sufficient calcium and if there is any idiosyncrasy against milk the women should take calcium lactate. In addition to diet all the women are x-rayed and suspicious teeth extracted but no major operations on the mouth are undertaken and no extensive dentistry of any kind.

Third Sets of Teeth. Editorial note in The Dental Surgeon, February 12, 1927, xxiv.

In reply to a query as to the possibility of developing a third set of teeth by a correspondent who had lost six permanent teeth by an accident the editor states that a woman physician wrote—giving her address—that she herself had cut three separate sets of teeth, no other information being supplied. The editor continues that reports concerning such experience constantly come to the front but unfortunately they are never properly documented. Such

reports never come from anatomists or dentists but from the public. The lucky woman, who is a Mrs. Dr. Watson, residing somewhere in London, now has a chance to come forward with proofs and exhibits. The editor likens the subject aptly to that of the sea serpents often reported as on view. The testimony is often faultless but somehow no such animal has ever been captured or found dead or snapshotted. The editor quotes from the current edition of Burchard's "Textbook of Dental Pathology and Therapeutics (1927)" in support of his own view. Thus far not a solitary example of third dentition has been completely authenticated. When after a person has become edentulous an isolated tooth appears this is not a true third dentition but a mere instance of a supernumerary or impacted tooth undergoing eruption. Sometimes several such teeth have appeared. Thus far we have been considering only the elderly, in whom a third dentition would suggest a rejuvenation. But in the very young subject repeated dentition is sometimes seen, as when the first crop of deciduous teeth is shed and soon followed by another eruption. Thus no less than three sets of deciduous teeth were cut by a child in the first two and a half years of its life, while at the age of eleven years a fourth set appeared and behaved like permanent teeth, although numbering but twenty-six.

A Psychic Factor in the Causation of the Paradentoses. Hans Sachs (Berlin). Vierteljahrreschrift für Zahnheilkunde, 1926, xlii, No. 4.

Various authors in seeking for the causal complex involved in pyorrhea have not hesitated to include mental elements and the present writer seeks to show that the mind might be a disturbing element in three ways: The first has to do with the flow of saliva which may be influenced by the emotional state and hence the amount of salivary calculus. The second is nocturnal gnashing of the teeth while the third is the composition of the blood. The author has frequently noted that emotional stress over a long period as during a spell of worry over sickness in the family will result in an increased deposit of calculus. This type of patient is freed from this trouble when the mental strain is removed. A considerable proportion of pyorrhea patients were found to be addicted to gnashing and grinding together of the teeth at night although not over one in four of those investigated. This habit appears at times to be associated with dreaming. The third factor, which the author styles the composition of the blood is somewhat misleading for what he has in mind chiefly is the composition of the blood with respect to the content of internal secretions, the pouring of these into the blood stream being due to a greater or lesser extent to the emotional state. This appears to be rather a speculative than an actual cause as no data are adduced to support the view. In an analysis of 68 patients the author found that at least half of them had shown nervous or mental disorders and this factor outnumbered any other single one. The majority of this group of patients showed no predominance of any particular disease factor and in fact seemed remarkably free from traces of some of the more common ailments either in themselves or families. About one in three showed anomaly of occlusion.

Periodontia and Preventive Dentistry. P. R. Stillman (New York). The Journal of the American Dental Association, January, 1927, xiv, 1.

A healthy mouth is a clean mouth and in any mouth condition which can be spoken of as unclean, restoration to health will mean cleanliness. In the past this order has been somewhat reversed by attempts to cleanse mouths without study of the underlying causal factors. To secure a healthy mouth the first thing to be considered is balanced occlusion which makes possible a proper circulation of the blood. In theory this is best accomplished by free use of the jaws, such as was doubtless a necessity to primitive man. Such vigorous activity is, however, out of the question and we have to resort to artificial vascular drainage, which of course makes for cleanliness. In pyorrhea it is now known that the successful treatment of advanced cases is in no wise different from that of incipient cases and it is also apparent that the management of the incipient case shades into and comprises the act of prevention. The borderline between physiology and pathology is where prevention comes to the fore and the periodontist has applied the engineering technic originally developed in making artificial dentures to the natural teeth and to securing physiologic occlusion. Abnormal occlusion is the chief factor in the ill health of the periodontium. When this is corrected the accumulation of detritus ceases and the bacteria have no chance to luxuriate and become virulent.

Unilateral Mastication as a Cause of Traumatic Occlusion. Editorial in Dental Items of Interest, February, 1927, xlix, 2.

Dr. Ottolengui, having addressed a form letter to several specialists in periodontia in respect to the possible causal relationship between unilateral mastication and traumatic occlusion, received replies at length. The letter states that gum disease is often more extensive on one side of the mouth and this seems also to be true of traumatic occlusion. Does one of these conditions favor the development of the other and which comes first? Is there a vicious circle involved? what are the consequences of unilateral mastication and what is the remedy? If a man neglects to chew on one side salivary calculus is the result and this is a cause of gum disease. Dr. A. H. Merritt mentions disuse atrophy in addition to salivary calculus as a result of unilateral mastication on the disused side which adds another factor to the causation of gum disease. Dr. A. F. James of Chicago does not believe that mastication of food is the cause of attrition of teeth which is rather the result of contact with the antagonists. This will be found to show bilateral symmetry and hence unilateral mastication may be left out of consideration to some degree. Dr. B. Tischler of Boston finds that while unilateral mastication is common it is not an important factor in traumatic occlusion. More important is a sort of habit spasm of the neurotic—a grinding together of the teeth. Dr. I. Hirschfeld agrees with the author and others that gum chewing after meals is a salutary custom. Unilateral mastication may of course be a factor in traumatic occlusion but not necessarily the most important one. Dr. Stillmann believes that traumatic occlusion comes before gum disease.

A Case of Rheumatism of Dental Origin. L. Rousseau-Decelle (Paris). La Revue de Stomatologie, February, 1927, xxix, 2.

This title would be commonplace in the United States but is very infrequent in Continental dental literature for in Europe the medical and dental professions look askance at our theory of focal infection. The author cites two French colleagues among the stomatologists who have previously published observations of this kind,—M. Nathan in 1923, and J. Troisier twice, in 1923 and 1925. The author relates his case in great detail and sums it up as follows: He did not try to prove the nature of the case of rheumatism which he believes was of dental origin by guinea pig inoculations after the American fashion nor did he try to make cultures from the joint fluid but despite these shortcomings he believes the weight of evidence is in favor of his view. The patient recovered after the extraction of certain diseased teeth. He of course cannot be sure that there were not other causal factors concerned. The condition itself cannot be regarded as new for the old clinicians used the terms cryptic infection for such cases. They suspected a focus although they could not point to one. Bouchard's "pseudorheumatism of cryptic origin" was in all likelihood of the same nature and due to dental or tonsillar or similar foci. The author has no idea as to the identity of the pathogenic germ for such bacteriologic studies as were made of the teeth gave negative results.

Preventive Dentistry in England. J. Sim Wallace (London). The Pacific Dental Gazette, March, 1927, xxxv, 3.

The author was brought to California by the State Dental Association, where he read a paper on preventive dentistry in England and the debt of England to America in the field of dentistry. He first paid a tribute to the pioneer work of Miller, Black, and Williams in the fundamentals of caries. To their labors and those of others we owe the possibility of giving rational instruction to parents and others concerning care of the teeth in children of school years, which is already bearing fruit. The leaflet given to parents as approved by the Council of the Society of Medical Officers of Health in England stresses the fact that the chief factor in caries is the fermentation of food that sticks to or between the teeth after eating, the acid product of fermentation being able to corrode the teeth. In this connection it is especially starches and sugars which should be avoided. Children from the first should be forced to chew food which offers some resistance to mastication. All foods should be as firm as possible. Mouth-breathing is a necessary adjunct to mastication in forming adequate dental arches without overcrowding of the teeth. Food which cleanses the teeth is useful as the last dish of the meal—fruits, nuts, etc. After the meal the toothbrush is to be used. It is estimated that under this régime, caries have been cut down in England by some 20 per cent which means a saving of nearly 10,000,000 cavities. Even this program of prevention does not include—as in some parts of the United States—periodical cleansing and scaling of teeth by the dentist which ought to reduce still further the amount of caries. Dr. Wallace warns against diet fads and even speaks of the present "vitamine craze" as in the faddist stage.

The International Journal of Orthodontia, Oral Surgery and Radiography

PUBLISHED THE FIFTEENTH OF EVERY MONTH BY

THE C. V. MOSBY CO., 3523-25 Pine Blvd., St. Louis, Mo.

Foreign Depots — *Great Britain* — Henry Kimpton, 263 High Holborn, London, W. C.; *Australasia*—Stirling & Co., 317 Collins Street, Modern Chambers, Melbourne; *India*—"Practical Medicine," Egerton Street, Delhi; *Porto Rico*—Pedro C. Timothee, Rafael Cordero 68, San Juan, P. R.

Subscription Rates—Single copies, 75 cents. To anywhere in United States, Cuba, Porto Rico, Canal Zone, Mexico, Hawaii and Philippine Islands, $7.00 per year in advance. Under foreign postage, $7.40. Volume begins with January and ends with December of each year.

Remittances—Remittances for subscriptions should be made by check, draft, postoffice or express money order, or registered letter payable to the publishers, The C. V. Mosby Company.

Contributions—The editor will be pleased to consider the publication of original communications of merit on orthodontic and allied subjects, which must be contributed solely to this Journal.

Opinions—Neither the editor nor the publisher hold themselves responsible for the opinions of contributors, nor are they responsible for other than editorial statements.

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Communications—Contributed articles, illustrations, letters, books for review, and all other matter pertaining to the editorial department should be addressed to the Editor, Doctor Martin Dewey, 17 Park Ave., New York City. All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 3523-25 Pine Blvd., St. Louis, Mo.

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Entered at the Post Office at St. Louis, Mo., as Second-Class Matter.

EDITORIALS

Arbitration as Related to Professional Services

AT THE last meeting of the American Society of Orthodontists a resolution was introduced calling attention to the advantages of arbitration in the settlement of disputes arising from professional services. Any one who has been engaged in the practice of orthodontia for a number of years, realizes that misunderstandings may occur between the orthodontist and the patient. These unpleasant conditions are prone to arise because orthodontic treatment extends over a long period of time and agreements which were made in the beginning may have been forgotten or incorrectly understood when made. These disagreements sometimes arise relative to the length of time required for treatment and also regarding the cost. Disagreements resulting from professional relations when taken to court are very unsatisfactory to both parties. In fact, the settling of business agreements by courts of law is so unsat-

isfactory in every line of endeavor that many of the best jurists and legal minds have tried for years to have these disputes settled by arbitration.

Consequently, there has been formed the American Arbitration Association with the result that arbitration clauses have been passed by legislatures in the states of New York, New Jersey, Massachusetts, and Oregon. Similar laws of this kind have passed both houses of legislature in Pennsylvania and California, and will probably be signed by the respective governors of those states. Ohio and Michigan also have arbitration statutes before the legislative session at the present time. The courts of the states of Washington and Colorado have by judicial interpretation ruled that arbitration clauses are enforceable despite the fact that their arbitration laws do not specifically provide for such enforcement. In the face of this recognition of the question of arbitration it seems that professional disputes could be more advantageously and efficiently handled according to the plan of the American Arbitration than if taken to court. Due to the above fact the following resolution on arbitration was passed at the recent meeting of the American Society of Orthodontists:

BE IT RESOLVED:

That it is recommended that each member of the American Society of Orthodontists insert in his written contracts or in his letters confirming an understanding reached with his patient, the following arbitration clause or one similar:

"In the interest of the retention of a friendly professional relationship, it is agreed that any dispute or claim arising out of or in connection with the orthodontic services referred to herein, shall be settled by arbitration under the rules of the American Arbitration Association."

This resolution was unanimously adopted by the members present.

Some men think that the insertion of an arbitration clause in a letter would arouse in the mind of the patient the possibility of a dispute. The experience of men who have been using the above arbitration clause is to the contrary. If the parent should inquire the meaning of the arbitration clause inserted in the letter, it can easily be explained to him that, owing to the fact that orthodontic treatment extends over a long period of time and that conditions may arise which neither party had foreseen in the beginning, it is well to have some way provided for taking care of these unpleasant difficulties should there be any misunderstanding. For example, time of treatment may be greatly lengthened because the parent insists upon taking the patient on long and frequent trips. Again the patient may be sent to a far distant school which will lengthen the time of treatment and very often make it necessary to do a great amount of extra work; also certain constitutional conditions may manifest themselves which were not recognizable at the beginning of the treatment. This especially refers to the unfortunate condition where roots of teeth absorb during orthodontic treatment. These absorptions may be the result of constitutional conditions over which the orthodontist has no control. The patient's parent may think such absorption has been the result of orthodontic treatment. Such questions could be much more satisfactorily settled to the contentment of both parties by arbitration.

Another unfortunate condition to be met with is the decay of teeth during orthodontic treatment. Patients are sometimes inclined to attribute caries

to orthodontic work when as a matter of fact we all know teeth decay that never undergo orthodontic treatment. In fact, if the dental profession limited its treatment of caries to patients who had worn regulating appliances, very few carious teeth would be treated, because only a small percentage of the public have had orthodontic service. Regarding the question of caries as related to orthodontic service, we wish to refer to a case that came under our observation only recently. A patient was presented for orthodontic treatment at which time an impression was taken, services contracted for, and an initial payment made. Conditions arose whereby the patient was not brought to the orthodontist again for a period of twenty-seven months, during which time thirty-eight cavities developed in the teeth. The fact was called to the parent's attention that if these thirty-eight cavities had appeared during orthodontic treatment, the parent would have attributed them to the appliance, and the parent agreed that undoubtedly he would have thought the appliance was the cause of the caries. Such an unfortunate circumstance, had an appliance been in the mouth, would have been a case for arbitration.

Regardless of the nature of the dispute that may arise during professional relationship, it can be more easily settled by arbitration than if taken to court. First, it can be taken care of in a very much shorter time and without the large amount of publicity that always results from court procedure. The merits of the case can be decided by individuals familiar with the condition under dispute. The case can be tried by an arbitrator selected for his knowledge and fairness of the matter involved or by a committee of arbitration which will consist of one person selected by each interested party and a third person selected by the two previously chosen.

The real great advantage of the arbitration clause when placed in the letter or contract is that it discourages suits by either party. The majority of suits are brought by some person who believes that filing a suit will force financial settlement which is entirely out of proportion to the matter involved. There is an increasing tendency for professional men who are familiar with arbitration to include such a clause in their letters and contracts.

The Eastern Association of Graduates of the Angle School of Orthodontia have adopted the following resolutions:

WHEREAS:

> The litigation of business disputes between dentists and patients results in loss of time, of money and of professional friendships and involves publicity and the revelation of confidential or intimate communications that are alike annoying to patient and to dentists, and

WHEREAS:

> Such disputes may now be settled speedily, economically and efficiently and with absolute privacy and with the retention of good will, under the arbitration law of the State of New York, NOW

BE IT RESOLVED:

First:

> That it shall be deemed to be more professional and dignified for members of the Eastern Association of Graduates of the Angle School of Orthodontia to submit such disputes to arbitration rather than to enter into a public court trial over such disputes:

Second:

That each member of said Society be urged to make every effort to agree with his patients to submit such disputes to arbitration, under the arbitration rules of the American Arbitration Association:

Third:

That each member of said Society take such action as he may deem advisable to bring to the attention of his patients his belief in and adherence to the principle of arbitration; and

Fourth:

That it is recommended that each member of said Society insert in all of his written contracts or in his letters confirming business understandings reached with his patients, the following arbitration clause, or one of similar intent:

"In the interest of the retention of a friendly professional relationship, it is agreed that any dispute or claim arising out of or in connection with the dental services referred to herein, shall be settled by arbitration under the rules of the American Arbitration Association."

It is our belief that with the American Society of Orthodontists and the Eastern Association of Graduates of the Angle School of Orthodontia on record as endorsing the principles of arbitration, every orthodontist will find it to his advantage to incorporate arbitration clauses in his contracts and letters. Some have asked what legal standing an arbitration clause incorporated in the letter would have. If the orthodontist when writing his letter regarding the business arrangement for professional services would close the letter as follows:

"If the plan outlined in this letter is agreeable to you, I shall expect to receive your check for the amount stated in the letter and also will expect the patient to keep the appointment he has (on the date mentioned)."

If the parent sends the check for the amount stated and the patient is brought to the office to keep the appointment, it is implied that the parent accepts the contract outlined in the letter previously sent. It is not necessary to have an acknowledgment by letter or to have the agreement signed, as the acts of sending the check and bringing the patient to the office show that the parent is agreeable to the plan outlined If the patient has done the above mentioned acts and later takes the case to court and the orthodontist presents the original letter which was sent at the beginning of the treatment, the plaintiff's case will be greatly weakened in the eyes of the court because it will be shown that he has not abided by the original agreement he entered into. In states where the courts have accepted arbitration clauses the plaintiff would be denied his day in court and would be told to settle his case in accordance with the original plan of arbitration.

A question has been asked what relation arbitration clauses would have to insurance policies covering liability. Such insurance companies as have been consulted on the matter of arbitration gladly accept the principles of arbitration as a means of speedily settling malpracticing suits and consequently diminish their court costs. Arbitration in no way interferes with professional insurance.